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SECTION OF GEOLOGY AND MINERALOGY

TRIASSIC LIFE IN THE SOUTHWESTERN UNITED STATES

By EDWIN H. COLBERT*

Introduction. In the southwestern United States, particularly in western Texas, New Mexico, northern Arizona, and southern Utah, there are vast exposures of colorful rocks constituting some of the most extensives areas of continental Triassic sediments in the world. These Triassic beds form much of the striking and highly-colored scenery for which the southwestern states are justly famous, and for this reason they have for many years been of unusual interest to many people visiting this region. To the geologist, the Triassic rocks of the Southwest are significant because they afford substantial clues as to the history of continental North America during early Mesozoic times, while to the paleontologist these sediments are of especial importance because they contain numerous remains of plants and animals that inhabited the land through the Triassic period.

Various investigators, representing a number of scientific institutions, have worked in the Triassic of the Southwest and have collected fossils from this region. In recent years, the institutions most active in the paleontological study of the southwestern Triassic have been the University of California, the Museum of Northern Arizona, the University of Texas, the University of Chicago, Yale University, Harvard University, and The American Museum of Natural History. At the present time, an extended program of research on Triassic vertebrates is being carried on at this Museum of which the collection and study of fossils from the southwestern states form an integral part. This program, which is concerned particularly with the Triassic of Arizona and New Mexico, forms the subject of the present contribution.

The Sequence of Triassic Sediments in Arizona and New Mexico. In Arizona, the lower Triassic is represented by the Moenkopi formation, which may rest upon either the Kaibab limestone or the Coconino sandstone, of Permian age. Above the Moenkopi, and separated from it by an erosional unconformity, is the Shinarump conglomerate of upper Triassic age, a persistent and characteristic stratigraphic and topographic feature in Arizona, while above the Shinarump and conformable upon it is the upper Triassic Chinle formation, perhaps the most widely exposed of the Triassic formations in the Southwest. Finally, above the Chinle, in many parts of Arizona is the Wingate sandstone of

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Jurassic age. In some localities, there is a layer of sandstone between the typical Chinle and the typical Wingate, designated by Camp and his associates as the "orange red sandstone," the age and relationships of which are debatable. Some authorities would associate the orange red sandstone with the Chinle below; others with the Wingate above.

The lower Triassic generally is not present in New Mexico, so that the upper Triassic rests upon the Permian in this region, the earlier period being represented by the Abo, Yeso, and San Andres formations or by the Cutler formation. At the base of the upper Triassic in New Mexico, there are commonly found sandstones and shales, the Agua Zarca sandstone, the Salitral shale, and the Poleo Sandstone. These are followed by characteristic Chinle sediments of upper Triassic age. Finally, in New Mexico, as in many parts of Arizona, the Chinle is succeeded by the Wingate sandstone of Jurassic age.

Distinguishing Characters of the Triassic Sediments in Arizona and New Mexico. The Moenkopi is composed of dark red or brown sandstones, alternating with thin shales. The Moenkopi sandstones generally are hard and resistant, with the result that they frequently form prominent ledges or cliffs, and these exposures of brownish or dark red resistant rocks are very distinctive features of the landscape. In addition to the heavy sandstones and the thin shales there are, within the Moenkopi, lenses of gypsum and limestone beds of local extent. In eastern Arizona, the Moenkopi is rather thin, having a vertical extent of a few hundred feet, but to the west it thickens, so that in southern Utah it may attain a thickness of two thousand feet or more. In this region, there is an interfingering of marine sediments from the west with the Moenkopi.

Formerly, the Moenkopi was considered to be barren of fossils, but work within the past few years by the University of California has shown that this formation contains a fauna of early Triassic fishes, amphibians, and reptiles.

In Arizona, the Shinarump is composed of gray or brownish sandstones and conglomerates which form a persistent and prominent erosional feature, and because of this the Shinarump has been mapped as a separate formation. It is, however, the opinion of many students of the Triassic sequence in the Southwest that the Shinarump is no more than a basal conglomerate and sandstone, properly to be included within the Chinle formation. This seems to be a logical view, for there is no distinct unconformity separating the Shinarump from the overlying Chinle; rather, the one grades into the other. It is an interesting fact that the Moenkopi, the upper surface of which is quite uneven, locally may project up through the Shinarump to form a direct contact with the Chinle, an indication that the Shinarump was nothing more than a basal sandstone deposited upon the uneven Moenkopi surface, and of such a small thickness as not to cover completely this surface. The Shinarump, which often contains silicified wood, generally has a thickness of from fifty to one hundred feet.

In northern New Mexico, there are also basal sandstones at the base of the Chinle formation. These are the Agua Zarca and the Poleo sandstones, and, where both are present in one locality, which is not generally the case, they are separated from each other by the Salitral shale. Each of these members has a thickness of about fifty to one hundred feet. It has been suggested by Darton that the Poleo, a massive, gray sandstone in which there are plant remains, may be the equivalent of the Shinarump to the west. If this is the case, the same probably applies to the Agua Zarca and the Salitral as well.

The Chinle is the most widely exposed of the Triassic formations in the Southwest, and the great areas of which this formation forms the surface are marked by their striking colors and badland topog-

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raphy. The formation, which may range from four hundred feet or less in thickness to more than a thousand feet, is characterized by a varied array of brilliant colors—reds, pinks, grays, lavenders, purples, chocolates, and greens. In the Painted Desert region, the Chinle colors reach their most variegated and brilliant expression. Soft clays and bentonites are characteristic of the Chinle, especially in its lower parts, and because of this it is generally a weak formation, eroding into rounded badlands. There are, however, numerous local lenses of sandstone, and these are most abundant in the upper portions of the Chinle as exposed in north-central Arizona, in the vicinity of Cameron.

The Chinle has produced abundant fossils of plants and animals, for which reason it is well known to students of ancient life. In parts of Arizona, the Chinle contains great quantities of petrified wood, particularly well exemplified in the region of the Petrified Forest National Monument. The wood, in the form of large silicified logs and stumps, is closely related to the modern *Auracaria,* now limited to the Southern Hemisphere. In addition to the remains of these great trees, the Chinle contains other plants, notably impressions of fern leaves.

Local deposits of unionid shells are common in the Chinle, indicative of the presence of river channels and shoals, in which extensive mussel beds were accumulated. The vertebrates, and especially the land-living vertebrates are, however, the most characteristic fossil animals of Chinle age. The fauna contains certain fresh-water fishes, such as might be expected in stream channels or small lakes, stereospondyl labyrinthodont amphibians, and various reptiles, notably phytosaurs, crocodile-like thecodonts that must have been ubiquitous and dominant during Chinle times, *Typothorax,* an armored pseudosuchian, *Placerias,* a dicynodont therapsid, and *Coelophysis,* a primitive theropod dinosaur.

TABLE 1

	Utah Arizona	New Mexico	Texas	Wyoming	Eastern U. S.
Jurassic	Wingate	Wingate			
	(Orange red sandstone)				
	Chinle	Chinle			Newark Series
Triassic			Dockum	Popo Agie	
	Shinarump	Poleo Salitral Agua Zarca			
	Unconformity				
	Moenkopi	Unconformity			
	Unconformity				
	Kaibab	San Andres			
Permian	Coconino	Yeso Cutler			
		Abo			

In northern Arizona, in the vicinity of Cameron, the orange red sandstone immediately above the Chinle and below the typical Wingate can be regarded as either of Triassic or of Jurassic age, and valid arguments can be advanced for either assignment. It was in this horizon that The American Museum of Natural History discovered, some years ago, the complete skeleton of an ancestral crocodilian, *Protosuchus*.

Correlation of the Continental Triassic Beds of North America. The lower Triassic Moenkopi probably has no real equivalent in North America. The upper Triassic Chinle, on the other hand, can be correlated in an approximate fashion with the Dockum of Texas, the Popo Agie of Wyoming, and the Newark Series of eastern North America. Exact correlations are not possible, but it would seem probable that the Dockum and the Popo Agie are equivalent to only a portion of the Chinle, probably the lower part. The vertical extent of the Newark series is a difficult question; it is probably equivalent to the entire Chinle sequence and possibly covers even more geologic time than does the Chinle formation.

The relationships of the Triassic formations of the Southwest to those of other parts of the continent can be represented as shown in TABLE 1.

The Triassic Faunas of Arizona and New Mexico. Turning, now, to a brief consideration of the fossil animals discovered in the Triassic sediments of Arizona and New Mexico, the following list is here presented, showing the stratigraphic sequence of genera.

Orange Red Sandstone
- Reptiles
  - Saurischia
    - Carnivorous dinosaur
  - Crocodilia
    - *Protosuchus*—ancestral crocodilian

Chinle Formation
- Reptiles
  - Saurischia
    - *Coelophysis*—primitive theropod dinosaur
  - Thecodontia
    - *Machaeroprosopus*—phytosaur
    - *Typothorax*—armored pseudosuchian
    - *Episcoposaurus*—pseudosuchian
  - Therapsida
    - *Placerias*—dicynodont
- Amphibians
  - Labyrinthodontia
    - *Buettneria*—stereospondyl
- Fishes
  - Holostei
    - *Semionotus*, *Lepidotus*—"ganoids"
  - Dipnoi
    - *Ceratodus*—lung fish
- Mollusca
  - Pelecypoda
    - *Unio*

(*Shinarump Conglomerate*)
- Fragments of phytosaur and amphibian bones
- Paleozoic invertebrates, secondarily deposited

Moenkopi Formation
- Reptiles
  - Thecodontia
    - *Arizonasaurus*, *Chirotherium*—pseudosuchians
  - Incertae sedis
    - *Anisodontosaurus*
- Amphibians
  - Labyrinthodontia
    - *Taphrognathus*, *Cyclotosaurus*, *Rhadalognathus*, *Aphaneramma?*, *Capitosaurus?*—stereospondyls
- Fishes
  - Subholostei
    - *Boreosomus?*—"ganoid"
  - Incertae sedis
    - *Leiacanthus*

Triassic Life of the Chinle Formation. The most common fossil vertebrate in the Chinle formation is the phytosaur, *Machaeroprosopus*. To judge by the evidence of the fossils, this reptile must have been widely distributed and very numerous during upper Triassic times, and it certainly must have been one of the dominant animals in the Chinle fauna. Of course, it should be remembered that the phytosaurs, being water-loving animals, lived in an environment where their bones were very likely to be fossilized, so that the frequency of phytosaur remains as compared with other Chinle reptile fossils may

be misleading to some degree. Nevertheless, there can be no doubt but that phytosaurs were very abundant in the Chinle rivers and swamps; indeed, their occurrence must have been similar to that of crocodilians along modern tropical rivers.

The phytosaurs played virtually the same role in Chinle times that the crocodilians do today. They were the aggressive, semi-aquatic predators that haunted rivers and swamps, to feed upon fish and any large animals that might come to the water to drink. It must not be thought, however, that the phytosaurs were ancestral to the crocodilians, because they represent a distinct evolutionary line that went through the course of its phylogenetic development and became extinct before the crocodilians arose in Mesozoic times. This offers a prime example of parallelism in evolution, of the similar development of two groups which, while unrelated, were nevertheless descended from a common ancestry.

This brings up a question. Why did the phytosaurs become extinct at the end of the Triassic period? Why should they fail, while the crocodilians, which succeeded them and imitated them so completely, were successful over a tremendously long sequence of geologic time ranging from the beginning of the Jurassic to the present day? Phytosaurs were distributed over North America and Europe during the upper Triassic, and seemingly they were very successful animals at that time. But at the end of the Triassic, they disappeared completely, and the crocodilians evolved to assume the same ecological niche that had been filled by the phytosaurs.

Typothorax and *Episcoposaurus,* pseudosuchians, were related to the phytosaur, *Machaeroprosopus.* Fossils of these two genera are not common, and it is possible that this may be due in part to the fact that these were upland reptiles, spending much of their time away from the immediate proximity of the water. They were heavily armored animals, and *Typothorax* attained a rather large size. Evidently, their very heavy armor protected these animals against attack by the phytosaurs.

A recent discovery by The American Museum of Natural History has unearthed, in northern New Mexico, abundant remains of a small, primitive theropod dinosaur, *Coelophysis.* This was a rather fragile little animal, six feet or so in length and lightly built, so that in life it probably weighed no more than forty or fifty pounds. Like all theropod dinosaurs, *Coelophysis* was bipedal; the hind limbs were used for locomotion and the front legs, which were reduced in size, were utilized for grasping food. The teeth, though small, were very sharp, and it is evident that this little dinosaur preyed upon small reptiles of various sorts. It was a quick, active little predator, viciously hunting its prey and keeping out of the way of larger reptiles by virtue of its agility and speed.

Heretofore, *Coelophysis* had been known from very incomplete material, but as a result of the recent discoveries by The American Museum of Natural History we shall now have abundant evidence as to the anatomy of these early dinosaurs. Numerous completely articulated skeletons were found piled on top of one another. What is the explanation of such an occurrence? What forces of extermination and deposition should bring together in one small spot so many beautifully preserved specimens? The deposit is remarkable, not only for the abundance of the bone and the articulation of the skeletons, but also because of the complete preservation, even down to the tiniest skeletal elements. It would seem to be a stream channel deposit, but conditions must have been unusual, to say the least, to account for this remarkable preservation of fossils.

Coelophysis probably was an upland animal, and the same was likely true of the therapsid reptile, *Placerias,* a large dicynodont reptile, closely related to the dicyno-

donts so typical of the Karroo series in South Africa. The discovery of complete *Placerias* material in Arizona by the University of California indicates that this reptile was a characteristic element in the Chinle fauna. Also, it adds to our knowledge of the distribution of the dicynodonts, which now are known from all of the continental areas. These obviously were widely distributed reptiles in Permian and Triassic times.

In contrast with the upland reptiles of the Chinle, the amphibian, *Buettneria,* was an inhabitant of rivers, lakes, and swamps. It was a large, stereospondyl labyrinthodont that secondarily had become almost completely adapted to life in the water. The skull was very flat and heavily ossified, as were the elements of the dermal shoulder girdle, but much of the remainder of the skeleton must have been cartilaginous, because bones other than the skull and the shoulder girdle elements are not common in the Chinle sediments.

Living in the streams and lakes with *Buettneria* were certain fresh-water fishes, notably the holosteans *Semionotus* and *Lepidotus,* ganoids with heavily armored scales, and the lungfish, *Ceratodus.* The presence of *Ceratodus* in the Chinle sediments is very interesting, since it gives us a good clue as to ecological conditions of that time. *Ceratodus* is closely related to the modern Australian lungfish, *Epiceratodus.* This modern lungfish lives in small pools that become much reduced during the dry season so that the water gets very foul. At such times, the lungfish is able to come to the surface to breathe air, and thus to survive in an environment inimical to most other fishes. It is logical, therefore, to assume that, during Chinle times, there were many small and stagnant pools, in which the amphibians and the lungfish were able to live.

The aquatic facies of the Chinle sediments are characterized by occasional deposits of unionid shells, which in some localities form extensive beds containing vast quantities of fossil molluscs. At one place in the Petrified Forest region there is such a deposit, where the shells weather out in countless thousands, forming a desert pavement over the slopes of the badlands. It seems quite obvious that deposits such as these indicate extensive mussel shoals in the rivers of Chinle times, very similar to the mussel beds that are found in present-day rivers and streams.

From this brief discussion of the life of the Chinle, it is possible to draw a picture of the ecological and faunal relationships that held during upper Triassic times in the southwestern United States. Evidently, this region was a low-lying flood plain, across which there meandered sluggish streams. To the west was the sea. It was a warm, tropical or subtropical land that supported an abundant plant and animal life. The flat expanses of the flood plain were interrupted here and there by volcanoes, which periodically ejected ash in great quantities. This volcanic activity, together with seasonal flooding and drying up of the rivers, resulted in the deposition of bentonites and stream channel sands, in which the plants and animals that are now preserved as fossils were entombed.

On the low uplands, away from the rivers, were forests of auracaria-like trees, while along the stream courses were giant horsetails, ferns, and other lush vegetation. Living in the woodlands and along the green bordered rivers were the various tetrapods of that distant age, while in the waters of the rivers and lakes were certain aquatic tetrapods and fishes.

The giant dicynodont, *Placerias,* was characteristic of the upland surfaces, as was the little primitive dinosaur, *Coelophysis.* The same habitat may have been the haunt of the armored pseudosuchians, such as *Typothorax.* It must not be thought, of course, that these animals were limited to the more upland areas, because it is evident that they also frequented the banks of the rivers. Here, however, life was dangerous for them, because of the presence of the aggressive, crocodile-like phytosaur, *Machaeroprosopus.* Sharing

this ecological zone with the phytosaur, and perhaps competing with it to some extent, was the large labyrinthodont amphibian, *Buettneria*. It is probable that both the phytosaur and the amphibian fed upon fishes, so it is not surprising to find that the freshwater fishes of the Chinle were well-protected by heavily armored scales. The fishes were holosteans, or "ganoids," and lungfishes—well adapted to life in waters subjected to periodic fluctuations.

Triassic Life of the Moenkopi Formation. The fauna of the Moenkopi, as based upon present knowledge, is neither so extensive nor so varied as that of the Chinle. Most of the tetrapod fauna consists of stereospondyl amphibians, which would indicate a prevalence of streams and swamps on a flood plain. The reptiles are known from incomplete materials, which indicate pseudosuchians of rather small size. The fishes are even more incompletely known, and such fragments as have been found show us that these were mainly holosteans with heavy scales.

On the whole, the picture of life in Moenkopi times is essentially similar to the picture of Chinle life that already has been drawn, and it is probable that, if the Moenkopi vertebrates were more completely known, the similarities would be increased.

Conclusion. Such is the story of life during Triassic times in the southwestern United States. It was a period of great importance in the evolution of the vertebrates, and especially of the land-living tetrapods. This was a time when amphibians and reptiles were in a state of change, when certain old lines were still holding on from earlier periods of dominance, when various new lines were still in the initial stages of their adaptive radiation. Thus, we see the labyrinthodonts in the streams and the dicynodont reptiles on the land as relicts of groups that were especially characteristic of the preceding Permian period. Peculiar to this stage in earth history was the dominance of the thecodont reptiles, the phytosaurs and the pseudosuchians. These were new lines of phylogenetic development that had their beginnings with the initiation of Mesozoic history, yet which were destined to die out at the end of Triassic times. Why these thecodonts, seemingly so well adapted and so successful during the Triassic, should not have survived the transition from the Triassic to the Jurassic period is one of those mysteries of extinction that so frequently occur throughout the extent of geologic history. Finally, in the Triassic of the Southwest, we now have as the result of recent work abundant evidence regarding the primitive theropod dinosaurs. This group, having its beginnings in the Triassic period, was to prove eminently successful during succeeding geologic ages. From small theropods, of which the Chinle genus *Coelophysis* is typical, there sprang the various lines of saurischian adaptive radiation, lines that were to persist through 100 million years of Jurassic and Cretaceous history, thereby establishing themselves as among the most successful of the land-living vertebrates.

GROUND WATER IN THE NEJD, SAUDI ARABIA*

By RICHARD BRAMKAMP† AND GLEN F. BROWN‡

The Nejd, Saudi Arabia, is near the center of one of the world's largest deserts, where economy is in delicate balance with water supply. Recent agricultural development requires expansion of the dominant supply derived from subterranean sources—wells in *wadi* floors and pits formed by solution-stoping of anhydrite and limestone.

The western third of the Arabian peninsula is occupied by a shield or nucleus known as the Nubian-Arabian massif around which are deposited sedimentary rocks ranging in age from early Paleozoic to Miocene. These beds form long arcuate cuestas emphasized by the variable nature of the sediments and the long history of wind erosion, the limestones forming topographic highs, the arenaceous beds forming lowlands and plains. The most important limestone cuesta group is the Tuwaiq mountains which extend from about latitude 19° north to 27° north along a curved path 1200 kilometers long. An extensive lowland on the west side of these limestone mountains is underlain by a non-marine sandstone, equivalent to the lower Mesozoic Nubian type of Africa. The Tuwaiq mountains are composed of several hundred meters of limestone, dolomite, and minor shale which dip eastward toward the Persian Gulf and include a bed of anhydrite in the upper part of the stratigraphic section. They are of lower Cretaceous and older Mesozoic age. Above them lies another important non-marine sandstone of middle Cretaceous age which forms the stretches of the white gravel plains on the east side of the southern Tuwaiq mountains.

Rainfall is scanty, probably not exceeding four inches per year, and of the desert torrential type. It has been sufficient to maintain three valleys across the Tuwaiq mountains in the area between Wadi Dawasir and Riyadh. Water is found in the gravels of the *wadis* after the winter rainy season of some years. The best water, lowest in total dissolved solids, is in those *wadis* having steepest gradients or those located nearest to uplands where evaporation and salt accumulation have been least active.

The trans-Tuwaiq *wadis* converge at Al Kharj, about 100 kilometers south of Riyadh, and the drainage line extends east as Wadi Sahaba. This confluence seems to be due to an antecedent drainage pattern developed on the arcuate pattern of the Tuwaiq table-land, the subsequent tributary drainage along the western sides of the cuestas, and a narrow graben, Shaib Nisa, which cuts through the Tuwaiq mountains directly west of Al Kharj. This graben was first noted by Mr. Max Steineke and subsequently studied in detail by Dr. Bramkamp. The latest work led to two other subsidiary grabens on the north of Shaib Nisa, neither of which is sufficiently active to control drainage except locally.

Movement of water eastward in this drainage pattern has dissolved anhydrite which lies beneath a remarkable cliff, the Hitt escarpment, extending from near Riyadh in the north to the vicinity of Laila in the south. Water in contact with the calcium sulfate is nearly saturated by the salt, and solution and collapse of the terrain in a belt about 12 kilometers wide on the west side of the Hitt escarpment have formed a valley by subtraction from below. The solution of anhydrite and the retreat of the Hitt escarpment eastward have been a function of time since Mesozoic and of sufficient ground-water gradient to remove water saturated with calcium sulfate from the anhydrite face. There is much evidence that periods of rapid solution have been separated by long periods of quies-

* Published with permission of the Arabian-American Oil Company and the Director, U. S. Geological Survey.

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‡ U. S. Geological Survey and Department of Geology, Northwestern University, Evanston, Ill. This paper, illustrated by lantern slides, was presented by Mr. Brown at the meeting of the Section on February 2, 1948.

cence. During one of the quiescent periods, the collapsed zone was submerged beneath a large fresh-water lake. Subsequently, fault movements on the eastern end of the Nisa trough started subterranean water circulation anew, removed anhydrite, and caused the Hitt escarpment to move east to its present position. In places, it appears to have moved about two or three kilometers in the last cycle. Locally, the water has dissolved out sufficient material to cause stoping through to the surface at the base of the cliff. Three of these pits, about 100 meters deep, are on the south side of the valley at Al Kharj, where the water is being pumped for irrigation purposes in the Kharj district and east onto the flood plain of Wadi Sahaba. The confined water of the calcium sulfate zone has spilled over into the *wadi* gravels, raising the flank of the normal gravel water table and causing evaporation and salt accumulation in the lowest part of the Kharj *wadi* floor.

Note. The Section of Biology held a meeting on April 12, 1948, at which Mr. Fairfield Osborn, President, New York Zoological Society, presented a paper entitled *The Planet and the Plunderer*, which was illustrated by motion pictures. No abstract of this paper has been received.

SECTION OF PSYCHOLOGY

PRESENT STATUS OF DEVELOPMENTAL AND REMEDIAL READING PROGRAMS AT THE COLLEGE LEVEL

By FRANCES ORALIND TRIGGS*

It has been said that every educator is, at heart, a missionary. I wonder if most readers would agree with this. I consider myself, first, a psychologist with special training in the field of reading, but in a larger sense I am first an educator. As such, I am sold on the thesis that, once we educators and psychologists understand the importance of reading as a tool, first, to gain personal breadth and adjustment, and, second, to gain understanding of personal and social responsibilities, we shall make great strides forward in aiding every student who passes through our educational system to attain reading skills to a much larger extent than we are achieving now. Therefore, I welcome the opportunity to discuss this subject. I have in mind a specific way in which I would like to present the subject and certain thoughts that I would like to leave which, if followed, I hope will affect action on the part of those in a position to develop reading programs in college.

The recognition of reading as a skill important to learning, especially in a society which governs itself, has been given careful consideration. Probably, the yearbooks of the National Society for the Study of Education are the most adequate record of this consideration, especially the Twenty-Fourth, the Thirty-Seventh, and the Forty-Seventh. To date the Twenty-Fourth Yearbook has sold 40,000 copies—a record even for a book of fiction. It was not until the last yearbook, the Forty-Seventh, which appeared in February, 1948, that major recognition was given to the fact that the development of these skills does not end with high school graduation. Its title is *Reading in High School and College.* Its theme is that reading as a technique of learning and self-development can be greatly improved even after students get to college; that many students will not be successful in gaining the understandings presented to them as they go through college, unless they receive careful help in developing their reading skills after they enter college.

In the present paper, I hope to show why there is the task before every college of consciously developing a reading program. I also hope to show how this can be done. Reading instruction in college must be, at the present time and for some years to come, of both a remedial and a developmental nature. The remedial or corrective phase should usually be handled by a specialist in the field of reading who is also a student counsellor or clinical psychologist. This work is needed by students who have not, up to the time of their entrance into college, developed what may be called the basic reading skills. The developmental program is best handled by each faculty member as he aids his students to achieve efficient learning in his specialized field. In this, the faculty member often calls on the reading specialist for suggestions and techniques, but ideally the developmental reading program itself will be in the hands of the professors teaching specialized subject matter, such as history, mathematics, English, psychology, etc. Reasons for this will be given later.

Can we define what the professor needs to know of reading, and learning to read, in order to aid students to utilize efficiently the specialized reading skills most necessary for efficient instruction in his subject matter field? I would mention the following*:

He needs an understanding of (1) the nature of reading as a psychological process; (2) the factors which contribute to

* Committee on Diagnostic Reading Tests, Inc., New York, N. Y. This paper was presented at the meeting of the Section on April 19, 1948.

* This topic is also discussed in the Forty-Seventh Yearbook of the National Society for the Study of Education.

reading difficulties and deficiencies; (3) the factors inherent in the curriculum materials he is presenting to the students which cause reading difficulties; (4) the relationship of reading to other learning tools such as visual aids; (5) the techniques for evaluating the extent to which students have attained or are attaining the reading skills necessary for success in the specialized subject matter in which he is teaching; and (6) the sources in the professional literature on reading to which he may turn when a so-called "reading specialist" is not at hand to give the help he needs. It is obviously impossible for us to approach or mention all of these subjects here, but there are two which I should like to review especially: the nature of the reading process, and the specialized skills needed for efficient learning in a few of the subject matter fields.

Reading, narrowly defined, is largely a perceptual act—specifically, visual perception—that process in which the individual's reactions are related to the printed page as the stimulus. It is a truism to say that, if there is no reaction on the part of the subject, there is no reading. Some specialists leave the situation pretty much at that, while others feel that reading is much more than that. However, one of the first principles every person working in the field should recognize is that the reader must master the perceptual act of reading. As long as his reaction to the stimulus of the printed matter is delayed by the perceptual act, he will never be an efficient reader and there are college students and adults who have never gotten beyond this stage in their development. This obvious fact is often assumed because other persons, having mastered these skills themselves, are unaware that such problems exist for some. What are the related terms utilized when this area is referred to? A few we may mention are word attack, word recognition, and the mechanics of reading. However, reading itself is a much more complicated act than the term, perception, may imply, as we shall see when we come to define the reading tasks of college students.

Before we discuss the specialized reading skills needed for reading in the content fields, it would be well for us to mention reading skills which must be developed. It should not be felt that this description is one agreed upon by all specialists in the field. Disagreement exists, and I can only give an explanation, not a scientific description.

The skills which might be mentioned can be classified under five main headings:

(1) *Word recognition,* largely based on the perceptual act already discussed. This involves being able to recognize words from total configuration and noting differences in words of like configuration by dividing words into syllables, ability to sound units of words such as syllables, at the same time recalling meaning from context, and using spoken vocabulary as a clue to meaning; recognition and recall of meaning of prefixes and suffixes, and root words; and, to some extent, grammatical structure. These skills are often referred to as the mechanical reading skills.

(2) *Vocabulary* (again based on word recognition and overlapping with the skills just described under that heading). This means vocabulary including deduction of meaning from context, knowledge of word parts, use of dictionary; appreciation of connotation, including word relationships, synonyms, antonyms, idioms, figurative or relational expressions; word history (etymology); word usage; understanding of symbolic expression, including maps, charts and diagrams, graphs, formulae, tables, signs, symbols, and relational expression.

(3) *Rates of reading skills,* including oral reading; skimming—to see whether the material satisfies one's purpose (*i.e.,* to get the gist of the content quickly) by noting chapter titles, marginal and other subheadings, topic and transition sen-

tences, key words, "signposts" (*e.g.*, therefore, however, and series words like first, second, third); rapid but thorough reading (the ability to combine speed and thorough comprehension); intensive reading —to trace the solution of a problem; ability to adapt reading speed to the reader's purpose, to the author's purpose, or to the type of material.

(4) *Skills used in apprehending meaning.* Ability to organize material including recognizing and formulating the central idea, finding details to support the central idea, seeing details in proper relationship, arranging events in sequence; ability to remember what is read, including reading with intention to remember, ability to concentrate, knowledge of helpful specific skills such as outlining, notetaking, underlining important points, making marginal notes, summarization by units, meditating on and discussing the material covered; ability to evaluate and appraise the material read (*i.e.*, critical reading), such as ability to locate supplementary information, including use of library catalogs, of periodical and book indexes, of other reference tools; ability to think logically (abstract thinking), such as to suspend judgment, to see the relation of the material read to reader's background and experience, time, and setting; to draw conclusions; to judge the author's performance by checking the validity and reliability of his sources, checking the accuracy of the author's inferences in the light of the material presented; ability to act on the basis of what has been read by following written directions, answering questions requiring reasoning.

(5) *Reading for appreciation.* Ability to visualize the situations and places described, to respond emotionally to the material read, and to appreciate tone and rhythm (especially in oral reading and poetry).

This classification, arranged roughly according to the complexity of the skills, is not meant to imply that the various skills are rigid, independent units within the reading process. They are all closely interrelated, and for this reason the diagnosis of reading difficulties can seldom be exact. It can show us the general area of the difficulty, and, from there on, remedial work must concentrate on improving all deficient skills included in that area.

Before discussing this, however, we should remind ourselves that, over and beyond the task of visual perception itself, reading requires the integration of thought processes stimulated by the perceptual act. Such psychological phenomena as attending, concentrating, remembering, recognizing the writer's purpose, the reader's purpose, the type of material with its specialized reading problems, are all related. An efficient reader uses these phenomena, more or less consciously, while the poor reader is likely to fumble through them largely unconscious of the fact that they exist.

The reading act, then, varies not only from person to person but from subject to subject, and, to complicate matters further, it varies with the individual in accordance with his purposes for reading, momentary as these may be at times.

Before discussing the reading tasks the college student faces and going farther into reading deficiencies which college students are found to have, I should like to tarry on two subjects: the problems readers meet in approaching reading in various subject matter fields, and the types of problems found in various college curricular areas. Perhaps this discussion will give some suggestions as to how some of these problems may be met.

The Reading of Prose Literature. We have heard the saying that the purpose both of the writer in writing and of the reader must be considered when reading. This is especially important in the reading of literature. The same piece of literature may not only be written for a number of purposes; it may be read to meet various types of needs of the reader. Possible

author's purposes may be to record historical facts, to tell a story, to affect social conditions, etc. The reader must not only learn to recognize the author's purpose but must also define his own, for he will utilize skills depending to some extent upon his own purpose for reading.

Literature is certainly one type of reading which affects personal development. Therefore, the aspect of the reader's purpose and his ability to choose material pertinent to his needs becomes of paramount importance. Also, the reader, if efficient, will vary the rate at which he reads material according to his need. His general conceptual background as well as the extent to which the vocabulary used is familiar to him will, to a large extent, be factors which will affect the rate at which he reads.

The rate at which literary material is read will also differ with the form of the literature. Drama, for instance, will usually be read more slowly than narrative form because visualization of actions normally intended to accompany the spoken word, with background supplied, must take place or much of its value is lost.

There is literature so written that its meaning is obvious on the surface, but also that which carries hidden meanings. If, by any chance, these meanings are similar to rich, emotional experiences of the reader, and the reading causes the reader to recall those experiences, the matter becomes even more complicated.

The matter of vocabulary difficulty has already been mentioned.

The reading of newspapers is perhaps our best example of the need for critical reading. Many students enter college with blind faith for anything they see in print. When they first meet two exactly opposite statements made in print, they become confused and unable to apply the normal "checking" skills to draw conclusions for themselves. Far too often, for lack of this skill, reading is not the growth experience it should be. The reader discards one or the other idea without any real reason for doing so, usually according to his previous bias. Perhaps part of each is true! Constant evaluation is necessary in certain types of reading if the reader is to gain.

Reading in the Social Studies. The first reading problem in this field is undoubtedly related to concepts suggested by the vocabulary used. True, some new and strange words will appear but, more important, words in strange connotations will come up. Metaphorical expressions are numerous. Examples might be "He can be depended on—Minnesota produces hardy stock" or "The real purpose of the Marshall Plan is pump-priming."

Included in this general problem are concepts of time and place. Such terms as sixteenth-century, ancestral homeland, a generation or so ago, must be given some reality through experience before they can be considered meaningful, though the words themselves are not difficult.

Methods of presenting quantitative data in the social studies are often strange and new to readers. Graphs, charts, maps of various kinds actually require a process of translation. The pictorial method of presenting data, instead of making this problem simpler, has actually complicated it to some extent. One has to go through an additional process before he gets the facts to translate. True, pictorial graphs may cause the readers to attend to them when otherwise many readers would overlook charts and graphs entirely.

The matter of critical reading, discussed earlier in newspaper reading, comes up again in reading of the social studies. It is a matter for real concern when, in one class, students may spend a semester learning to form concepts based on what they thought to be adequate facts without ever considering the other side of the problem. If those concepts are based on current happenings, they must learn to hold their conclusions in abeyance while the facts are tested by time. How can a student, when reading, determine the adequacy of

the data presented? He must be shown. All propaganda is not bad, but students must be able to judge when material being presented to them falls in this area. They do so by critically weighing material as they read, holding in their minds the meanings gained from reading until they can weigh and test conclusions drawn.

Reading in Mathematics and Science. In the chapter which discusses the reading of mathematical material in the Forty-Seventh Yearbook of the National Society for the Study of Education, *Reading in High School and College,* four major reading problems are covered: first, the language of mathematics, which includes literal numbers, operational symbols, arithmetical numbers, and expressions of relationships; second, the vocabulary of mathematics; third, obtaining meaning from symbols; and, fourth, problems relating to the compactness of the writing.

These problems, to some degree, are the same problems which arise in reading science material. To overcome them, the student must know how to adapt his reading speed to the point where he gets most efficient comprehension. He must be able to translate into his own words the symbolic language, and he must enrich the material read from his own experience because of compactness with which it is written.

The Reading Deficiencies of College Students. When reading disabilities of students are mentioned, the one which students coming to the clinic most frequently identify and complain about is reading too slowly. Too often, rate of reading is identified as an entity in and of itself unrelated to the purpose of the author, the reader, or the type of material being read. The job of the reading clinician is to determine the reason or reasons for slow reading: inadequate vocabulary, habitual slow reading, poor perceptual or recognition skills, and poor concentration often due to problems of adjustment. Remedial work depends on the diagnosis.

Inflexibility of reading skills is closely related to slow rate of reading. An illustration might be given. A student given a reading list from which to select supplementary reading on a topic to be developed for class discussion must be able to skim the references to determine whether they are pertinent to his needs. It may be found that the material is pertinent, but essentially covered by other references. Usually, it must be quickly read anyhow to be sure that no new content is included. All of this adaptation requires flexibility of skills.

Some students do not know how to attack words not already in their reading vocabulary. Therefore, if new words are contained in the material read, the student must master them before he can read with meaning. Reading of formulae, charts, graphs, and other methods of presenting data must be mastered also. Critical reading, as already mentioned, is a problem for some students. All students, even though their basic reading skills are good, must learn to adapt their skills to the specific content they are reading.

All of the difficulties mentioned above stand in the way of efficient critical reading. In order to read critically, a reader must bring something to his reading from his experience and previous reading. He must also know why he is reading and apply the appropriate skills for the purpose. There is very little of any experience in life which can be accepted uncritically. This students fail to understand as often as not, and many graduate from college with no appreciation of that fact at all. Many colleges assume students knew it when they entered college. As a result, they never learn the importance of critical reading and critical thinking. A number of special techniques have been developed to bring this forcefully to the student's attention in the area of college reading assignments.

The emotional problems which are in some way related to reading disabilities of any identifiable magnitude at all cannot be

overlooked if successful remedial work is to be done. Also, reading as a therapeutic technique, including bibliotherapy, is a very interesting and useful tool in the hands of a trained clinician.

While this list of disabilities is not exhaustive, it is illustrative of the deficiencies college students are found to have.

The Reading Specialist in the College Reading Program. We have mentioned the part the professor may play in advancing the development of reading skills of college students. What can the specialist in reading do to aid a college in setting up a reading program? He can work with the faculty members in individual departments, helping them to identify the specific reading problems in their curricular fields and suggest techniques which may be used with groups or in regular classes, as well as ways of evaluating the results of the work. He can also aid departments by handling the problems of individual students referred to him by the faculties of the departments, who do not respond to the group or class work.

To do a good job in work with individuals, he must, as the Yearbook suggests, combine the qualities of an educator, clinical psychologist, therapist, and an expert teacher. He must have a broad understanding of the mental, physical, and emotional growth of young people and a thorough knowledge of the psychology, physiology, and sociology of reading, for one of his jobs is to identify, diagnose, and treat problem cases in reading through a formally conducted reading clinic. To do this involves the treating of all the usual emotional problems which may be the cause of reading problems, the result of them, or both. The remedial work is, therefore, also affected by them.

The College Reading Program. How should colleges interested in developing better reading habits and skills approach the task? There is no one answer, but the interest of the entire faculty and administration must be elicited. The major part of any really successful program will be carried out by the faculty. This may be done by first furnishing expert help to the faculty through a reading specialist. The faculty members will refer to the specialist students who are obviously having trouble, and will get help from the specialist on reading techniques they can use in the classroom. The reading clinic, administered by the specialist, will handle the individual students referred for special help. To be of most help to those students, the reading specialist will need various types of help from the faculties of the various departments, both on general approach and on the work with individual students. The evaluation of the program should not be overlooked. Such evaluation will again be carried on jointly by the faculty, and the total reading program will be modified on the basis of the findings.

To summarize, then, it is my belief that, if colleges are to do their job today efficiently and well, they must give more attention than they are doing at present to the development of reading skills to a more efficient level than their students have when they enter college. To do this, it would probably be necessary for the present to have a remedial program, which should be in the hands of a trained clinician. This clinician will work with students to develop efficient basic reading skills. The larger job of developing students' skills will be done through the developmental program carried on in the class room. The specialist in reading will be able to help the college in a number of ways to establish and maintain a reading program, which, therefore, would not just be something added to the work of already overburdened professors. It is a way, actually, of relieving them of a problem they now face—students who do not read efficiently enough to profit from college work —and thus to remedy a situation in which neither the professors nor the students do their best work.

I should like to close by mentioning again the social implications of reading.

We proudly call our form of government democratic. This implies government of and by the people. No such government can stand without the active interest of every citizen, which means educated citizens, and no one remains educated without continual effort on his part. Reading is the one most important tool in our present-day society for our continued education as citizens after we complete our formal schooling. In colleges, today, we are not presumptuous enough to think that we teach students what they need to know throughout life. We hope, however, that they do gain resources such that they can continue to learn in order to carry their social responsibilities and to continue their personal and social development. Reading is, I think, the greatest avenue to learning today. Radio and motion pictures are vieing with it for their places as avenues of learning, but as yet they cannot begin to compete. If the individual citizen can read efficiently, there is almost no end to the possibilities of using that skill as a cheap and effective avenue of learning and enjoyment. As I said in the beginning, when we, as educators, are convinced of this fact, we shall begin to place the stress we should on the development of efficient reading skills in college. We shall not feel that our job is finished until students have attained efficiency in reading to the extent that the adult population, or at least that portion of it which graduates from college, is a reading public—a state of affairs which all research in this area has indicated not to be prevalent at this time.

Editor's Newsnote

Doctor John E. Vance, associate professor of chemistry at Yale University, has been appointed chairman of the Chemistry Department at Washington Square College and head of the Chemistry Department at the Graduate School of Arts and Sciences, New York University. He will assume his new duties with the opening of the Summer Session.

Professor Vance received his doctorate from Yale in 1929 and subsequently studied at the University of Copenhagen under a Sterling Fellowship. Upon his return, he joined the teaching staff at Yale. He entered the Chemical Warfare Service in 1942 and was transferred to the Manhattan District of the Corps of Engineers; among other missions, he was sent to Bikini as a technical adviser.

After returning to Yale in 1946, Professor Vance was appointed to the staff of the United Nations Atomic Energy Commission. Besides being a fellow of the Academy, he is also a member of the American Chemical Society and of Sigma Xi.

—Information supplied by the New York University Bureau of Public Information

SECTION OF ANTHROPOLOGY

THE PASTORAL PEOPLES OF NORTHWESTERN KENYA

By KEPLER LEWIS*

One year ago (April 10, 1947), the Morden African Expedition sailed from New York for British East Africa. One of its major objects was to make an ethnographical collection from an East African tribe for the sponsoring institution, The American Museum of Natural History. From this side of the Atlantic, it was difficult to decide on a tribe. We wanted a group which had not been too much acculturated and one which would not duplicate collections already in the museum.

A little research after our arrival in Nairobi indicated a tribe in northwestern Kenya Colony, the Turkana, as ideal for our purposes. The Turkana are an isolated people with little European contact. Their country is too arid to attract farmers and ranchers, and the natives had hunted so thoroughly that most of the big game had been cleared out before African hunting became an international sport, so that they were spared the many game safaris which still penetrate the Northern Frontier Province east of Lake Rudolf.

As far as we know, the first Europeans to enter this part of Africa were Count Teleki and Captain von Höhnel, who came around the south end of Lake Rudolf 63 years ago. They were impressed by the astonishing physiques of the natives and by the fact that they were such a lively, noisy and impetuous people. In 1896, Vittorio Bottego explored some of the area west of Lake Rudolf. He was followed by H. S. H. Cavendish and Major H. H. Austin, but the country never became a popular corridor for traffic. It did not come under British civil administration until after the first World War, and until 1921 there was an official Ethiopian governor of Northern Turkana. As late as 1930, there had been no general topographical survey of the area.

The eastern boundary of northwestern Kenya is well marked by Lake Rudolf, about 180 miles long and some 20 miles wide, and by the Samburu Escarpment, the eastern wall of the Great Rift Valley. The western boundary is formed in the north by the Uganda Escarpment and further south by an arbitrary line dividing Kenya and Uganda. The northern boundary line with the Anglo-Egyptian Sudan is based on neither geography nor ethnic distribution.

The highlands which mark the southern border of the region range from about 5,000 feet to nearly 11,000 feet in elevation and have sufficient rainfall for subtropical agriculture. There are deeply eroded valleys, mountain streams, and water falls. The cover varies from grass to thick bush on the hills and forest along the streams.

The west wall of the Rift Valley towers nearly 2,500 feet above the plains on its floor. From the base of the escarpment, these plains slope gently downward toward Lake Rudolf, which stands at just under 1,300 feet elevation. The plains vary from arid sandy steppe country to true desert. There are many minor streams winding through the country, but nearly all of them are dry most of the year, though a small shower will turn them into raging torrents for a few hours. There are several major streams which cross the plain from the western and southern highlands and they, too, are dry much of the year. The floor of the valley is broken in many places by stark mountain formations.

Vegetation is mostly confined to weeds and thin scrubby acacia bushes except along stream beds, where very fine trees may grow. Some sections of the plain are almost devoid of cover. However, last July, the Lodwar region had several showers of rain, and within a few days

* Columbia University, New York, N. Y. This paper, illustrated by motion pictures, was presented at the meeting of the Section on April 26, 1948.

there was an astonishing amount of plants and flowers.

There are parts of two large tribes living in this northwestern section of Kenya Colony: the Turkana, who are completely pastoral, and the Suk, many of whom combine agriculture with a pastoral life. There are now some 75,000 Turkana, wandering, with their livestock, over 25,000 square miles of the floor of the Great Rift Valley. They are a collection of similar ethnic groups which are, in turn, part of a still larger grouping of peoples all speaking mutually intelligible Nilo-Hamitic languages: the Donyiro and Topoth in the Anglo-Egyptian Sudan, the Dodoth, Jie, and Karamoja in eastern Uganda. The Kenya people refer to their language as Turkana and call themselves Turkana. Their closest ties are with the Jie, whom they consider blood relatives. According to legend, they were once a part of the Jie tribe living on the top of the Uganda Escarpment. A young bullock once strayed away and some of the young men who were hunting it came down to the upper Tarash River in what is now north-central Turkana. The country was empty and full of good berries and good grazing, so that there was a general movement into the new area. This migration probably took place less than 100 years ago. As a matter of fact, the Turkana have moved nearly 100 miles to the south since they were first contacted, and there is still a tendency to move to the southeast, which is resisted by the British administration.

The Turkana are excellent physical specimens. They appear to be an inch or so above the average European stature and are not inclined to body fat, though this latter may be due to food habits. To the eye, there seemed to be two generalized physical types, a short, heavily muscled man with many negroid facial traits and a taller type, lightly muscled and with fewer negroid traits. There are, of course, many variations of these types. However, without a thorough anthropometric study of the tribe, it would be difficult to determine just what part these generalized types play or even if they actually exist. Skin color ranges from coffee brown to black and the hair is universally negroid. The women average some four or five inches shorter than the men.

The health of the tribe is probably very good. Malaria does not play a major role in most of the area because of the extreme drouth. Conjunctivitis and other eye troubles are said to be fairly common. Venereal disease is unusual except around the stations, and Turkana girls who have contracted a venereal disease from some member of the native police patrol have been known to walk many miles into the station for treatment. The only physical malformation I noted commonly was ruptured navel. Possibly, the good health of the tribe is due to the fact that the life is hard and only the fittest survive.

Social Organization. The Turkana can be divided into sixteen major, named, territorial groups. In turn, there are twenty-eight groups of exogamous, nonlocalized, patrilineal sibs, most of which are represented in each of the major territorial groups. These patrilineal sibs are called *emacher* (brands) and each has a distinctive stock brand. Though these brands vary somewhat from group to group, I found that most of the stock brands collected around Lokitaung in the northern part of the district were readily recognized and named by Turkana around Karpeddo more than 200 miles south. The only functions of the patrilineal sib, so far as I could determine, were, the regulation of marriage, marking of stock, and payment of tax to the government.

The gentes are further divided into moieties. These are the *Ngimur* (stones) and *Ngirithai* (leopards). The son always belongs to the moiety opposite to

that of which his father is a member. Strangely, in a system which alternates by generation, the members of *Ngimur* have somewhat more prestige than the *Ngirithai*. To the former is confined the right to wear black ostrich plumes, aluminum or iron ornaments, and giraffe's tail. The latter reserves the right to use white ostrich plumes and brass or copper ornament. Each moiety has its peculiar song subjects, though some ornament and songs are common to both sections. These moieties now seem to have little social or ceremonial function and may be on the wane. Girls are said to belong to their father's moiety until they marry, when they change to the husband's moiety.

Another set of social groupings is based on age. Males pass through four age groups: *Ngabanak,* (all pre-adolescent boys), *Esorok,* (post-adolescent boys), *Ngiliok,* (adults of warrior age), and *Ngathiku,* (aged). There are four similar age groups among women.

Puberty ceremonies are held for boys, and after the ceremony, which consists of the slaughter of a bullock by the candidate and the making of his first head-dress by his sponsor, the boy is a member of the *esorok* group. This is the only age group with a formal entrance ceremony. The Turkana do not circumcise. In addition to the four age groups through which each Turkana male must pass, the youth becomes a member of a permanent age set. These sets are created at about five-year intervals and are given such names as Zebras, White Camels, Full Rivers, etc. A man remains in his age set until death, and his set becomes senior as the older groups die off. The age groups and sets seem to play very little part in the life of the Turkana.

Domestic Life. The sparse browsing available for the livestock has forced a nomadic life on the people. The *awi* (village) is usually made up of an extended family—a man, his wives and children, and other assorted relatives. The *awi* may have 10 or as many as 40 people living in it. Except along the three or four streams which carry seasonal runoffs from the highlands, agriculture plays no part in the economic life of the people, and even in these places the crop is confined to a few small kaffir corn patches.

The whole subsistence basis of life is livestock: cattle, sheep and goats, camels, and donkeys. In spite of the poor grazing, cattle are found in all parts of the valley floor. The original wealth basis of the Turkana must have been built around cattle. Sheep and goats are well suited to the climate and terrain and are increasing so rapidly that the British administration is faced with the difficult task of reducing their density to prevent overgrazing. Both camels and donkeys are very well adapted to this country and one would have to go far to find better specimens of either.

All livestock is milked except donkeys, and I have heard that some Turkana milk the donkey. However, none of the animals can give much milk on the thorn bush diet. The people drink the milk fresh or soured and eat it clabbered. Some of the milk is churned in a wooden jug with skin ends to make *ghee,* a liquid butter which is eaten or used to grease the body.

An important addition to the milk diet is blood. The animal to be bled has a noose put around its neck and pulled fairly tight. This causes the superficial veins of the neck to swell. A vein is punctured with an arrow shot from a small crude bow held a few inches from the animal's neck. The arrow is unfeathered and has a metal blade set in the foreshaft. This is the only use the Turkana make of the bow and arrow. Stock bleeding is usually done by young men, but I have seen it done by boys and girls. After the vein is punctured, the blood is caught in a wooden bowl

and stirred with a stick as it flows. The blood clots on the end of the stick and the remaining blood serum is either used raw and fresh or it is mixed with milk and drunk. As much as half a gallon of blood may be drawn off at one time from a cow or a camel, and the animal is not bled again for two or three months.

After the morning milking at the *awi*, the herds are sent out to graze separately in the charge of the young men, boys, and girls. By mid-morning, the herders have started the stock for the water holes along the river. In some areas, the Turkana are fortunate enough to have access to permanent water holes, but most of them must excavate wells in the dry sandy bottoms of the river beds. The job of scooping up the water and handing it up to the water trough falls on the young girls and women. Most of the water holes I saw in central Turkana were only four to six feet deep, but in the dry parts of southern Turkana these holes may go down twenty or more feet and four or five girls are needed to pass the wooden bowls of water up from the bottom.

Stock is watered every day if possible, but in very dry seasons it may be done every other day. Camels may even go three days between waterings.

The whole life of the people is centered around their livestock, but in spite of this they are very casual stockmen. No thought is given to breeding or care. Some Turkana are unnecessarily brutal to the animals.

In addition to the blood and milk diet, meat is eaten when an animal dies or when it is slaughtered for a ceremonial occasion. Such wild resources as are available are used. There are several types of berries and roots which are edible. From the few stores at the stations, the Turkana buy or trade for maize meal, tea and, most important of all, tobacco. The tobacco is a strong fibrous mixture which both men and women set great store by.

Some hunting and trapping is done, but game becomes more scarce by the year. The only animal present in any quantity today is Grant's gazelle.

Though the Turkana were not originally a fishing people and many of them will not eat fish, some of the groups living along Lake Rudolf have taken to fishing. At Namoruputh on the Ethiopian border, a fairly large permanent village, which depends largely on fishing and trade with the Merille, has been established. Fishing is a communal activity and is done by a drive through the shallow water, each man using a trap of net over a hemispherical wooden frame.

Political Organization. Until the British arrived, there were no chiefs or headmen. Each *awi* functioned under the leadership of the paternal head of the family. In any problem which arose affecting a section of the tribe, decisions were made by a group of the elders, and their prestige was such that the decision carried weight with the section. There was great difficulty in organizing any reasonable part of the tribe for warfare, so this was confined to raids and counterraids by the younger men. For purposes of administration, the British have appointed chiefs and headmen in the territorial sections of the tribe, and the system seems to be working very well.

The Village. Away from the two stations, it is unusual for an *awi* to be in the same location for more than two or three months. Houses are little more than rough brush shelters. There is a low, dome-shaped bower which is covered with skins or with long grass if it is available. A few feet away, there will be a larger shelter (7 to 9 feet high), shaped like a large dome cut in half. Each wife has a similar set of these shelters, which she builds for herself. The smaller one is used by the women and children as a sleeping hut and

the larger provides shelter from the sun and a place to work during the day.

The whole *awi* is surrounded by a thorn fence, inside of which are smaller fenced areas for the various sorts of livestock. The *awi* is built by the women and girls. Because of the dry air and frequent moves, the villages stay reasonably clean. They are not nearly so fly-infested as the semi-permanent villages of the Karamojong.

When the decision has been made to move to better browsing areas, all the personal effects and household equipment of the *awi* is loaded on the backs of donkeys and the move takes place. Camels are not used by the Turkana for transportation. A characteristic feature of the Turkana landscape is the large number of abandoned villages.

Dress and Ornament. Most of the emphasis in male costuming is placed on the head-dress. The hair on the back of the head is mixed with gray clay and molded into a bun. Built into the bun are several coils of wire which make plume sockets for ostrich plumes. Another smaller clay bun is built on the forepart of the head. Some men wear the curved handle of a calabash curving forward over the head from the rear bun. Others use a more spectacular arc-shaped rod made from thin strips of horn, on the end of which is a pom-pom of feathers. These head-dresses are most attractive, but delicate, and a man must use a wooden pillow for sleeping. During the day, the wooden pillow serves as a stool and is carried everywhere (see FIGURES 1 and 2 for illustration).

The ears are pierced for small aluminum rings and the septum of the nose is pierced so that a large leaf-shaped shield can be suspended over the mouth. One of the most striking ornaments is the labret of ivory or aluminum worn in the lower lip. Some of the ivory labrets are round and almost as large as a billiard ball. Brass or aluminum wire is wound around the upper arms and many brass or iron bracelets may be worn. Today, many men wear an *"americani"* cloth toga knotted on the right shoulder, but a few years ago men preferred a skin spine pad and a skin buttock cover. The genitals are not covered. All men wear leather sandals. Small boys do not bother with clothing of any sort.

From infancy, girls wear a small triangular leather apron trimmed with ostrich egg shell beads, and later a longer skin buttock cover is added. Except in size, these aprons do not change until the girl has reached the age of puberty, when she starts wearing a rectangular-shaped apron with the hair left on the outside. The back apron also has the hair left on, and it has heavy gussets sewed in to help the apron swing when the girl walks. This apron hangs as far down as the middle of the calf. In addition, a leather overall tied over the right shoulder and leaving the left breast bare is often worn.

The hair is shaved on both sides of the head, with a center roach left. The hair in this center piece is twisted into strings with red clay and fat. A woman wears many small earrings and as many necklaces of trade beads and seeds as she can come by. Two anklets made of the discarded ends of spears are worn on either leg. Both the lower and upper arms may be bound with aluminum or brass wire. Women also wear labrets, but never the large ivory balls used by the men.

Weapons used here are characteristic of most of the tribes to the north and west. The men carry one or two spears with leaf-shaped blades, a center shaft of wood, and an iron shoe. The spear may be seven to nine feet long, and, when carried in pairs, they are usually very well matched. The blade is covered with a leather guard. Every man carries a stick with a hockey-club end, and most men wear wrist knives (see FIGURE 3). This is a circular flat knife with one side opened so that it can be slipped on the wrist, which is protected by a leather guard; the edge of the blade also has a leather guard. The knife is worn on the right wrist.

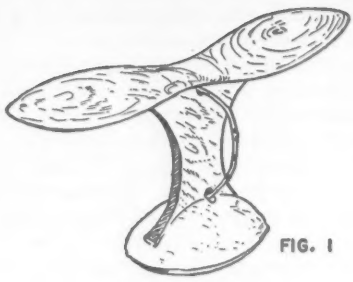

FIG. 1

HEIGHT 6 IN.

FIG. 2

HEIGHT 8 IN.

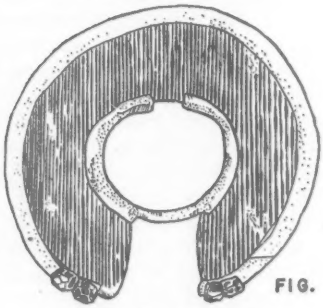

FIG. 3

DIA. 5 IN.

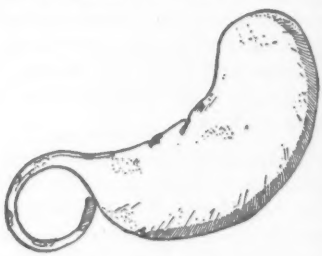

FIG. 4

LENGTH 4 IN.

FIGURES 1-4.

Another murderous knife (FIGURE 4) is a large blade worn as a ring on the middle finger of the right hand. This knife does not have a leather guard. A narrow rectangular shield made of tough hide or of wicker was once carried by the Turkana, but these shields are becoming rather rare now.

Dancing. The favorite pastime is dancing, and any occasion which brings together several families may call for a dance. There are war dances, dances for the evening or day, hunting dances, and dances to bring good fortune. The Turkana dance very well and seem tireless. A dance which started one day at noon at Namoruputh was still going strong two days later. One of the most popular dances is the *Adonga,* in which the men sing about their cattle and jump up and down in a stiff-legged, rigid see-saw with the women, who dance facing the men, jumping on the off-beat. Women take part in nearly all of the dances, some of which are, in fact, rather erotic in character.

Conclusion. From both literary sources and native tradition, it appears that the Turkana are relatively recent migrants into the plains on the floor of the Great Rift Valley. They came as cattle-herding pastoralists and are being slowly reduced to sheep and goat herders by the aridity of the country.

Prestige which was once based on success in war and cattle raids and on the ownership of large herds has been terminated by the British administration, which has stopped the raiding, as well as by the poor grazing which will not support great

herds. No new prestige substitute has been found; yet, the Turkana are a thriving people, well adjusted and happy. The population is increasing and the penetration southeastward still continues in the guise of labor on roads and on farms. Though the Turkanas seem to be one of the poorer tribes in Kenya, from a material standpoint, their material culture has penetrated all the neighboring tribes while they, themselves, have resisted influences from the outside.

The social organization, which is now so simple, shows traces in the decoration moieties, age sets, and age groups of once having been more elaborate and complicated. It is interesting to speculate on the reasons for the atrophy of some of these social elements—whether it is a result of the dislocation of a small, tightly organized tribe into a great empty area, or whether it is part of a process going on in all the kindred peoples of the Turkana. Only considerably more research among the tribes to the north and west can answer this question.

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ON THE CONCEPT OF CREOLE CULTURE IN PERU[1]

By HARRY TSCHOPIK, JR.*

The importance of understanding Latin America and Latin Americans is so obvious as to require no justification. During World War II, the need for inter-American solidarity was very real and immediate. The peace-time need for continued cooperation based on mutual understanding is no less urgent. "Any program of intelligent planning for human adjustment either for the present or for the future," wrote Gillin,[2] "must rest upon sound information concerning the physical make-up and cultural and social development of the population." It is in this field that anthropology is in the position to make a unique contribution. Because of his professional training and his first-hand knowledge of Latin American society and culture, the anthropologist is able to describe and classify these various ways of life in terms intelligible to the members of another culture. By detailing the content and orientation of the Latin American cultures, he provides a concrete basis on which statesmen, social planners, and business men may act, if they will. The proposed agenda for the forthcoming Second Inter-American Conference on Indian Life, moreover, make it abundantly evident that, throughout Latin America, those responsible for action programs—in education, public health, economics, and in many other fields—feel the need for more workable classificatory schemes descriptive of the various ways of life encountered in Latin American countries.

One of the most recent of the classificatory devices which has as its objective the delineation of a way of life in Spanish America is John Gillin's concept of "Creole" culture. It is the purpose of the present paper to examine the utility of this concept with special reference to a particular Latin American republic—Peru. First, however, it will be necessary to consider very briefly some problems which relate to Spanish America as a whole in order that the Peruvian situation may be seen in proper perspective.

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I

In recent years, ethnological investigations and community studies in Latin America have indicated repeatedly that the cultures of the contemporary aborigines inhabiting that region formerly occupied by the pre-Columbian high civilizations of the New World—a region which extends roughly from the Bolivian plateau to the Valley of Mexico—may not be considered "Indian" in the sense that anthropologists are accustomed to speak of the "Indian cultures" of, say, the southwestern United States and of the Plains. In the latter areas, aged Indians may be found who are able to recall (usually through stories related to them by now-deceased grandparents) the tribal way of life as it existed before pronounced White contact. In Spanish America, however, after some four hundred years of European cultural domination during the Colonial era and afterward, the cultures of the contemporary aborigines have become so mixed that, in some cases, it is next to impossible to know what patterns are of native origin and what are not.[3]

This is not meant to say that, in the Latin American field, we are never justified in speaking of "Indian culture"; it simply means that the framing of "Indian culture" differs somewhat from current North American usage. In such a Latin American republic as Peru, for example, it is impossible to discover a single highland community whose culture has not been influenced in some measure by Spanish tradition. Nor is

there a single living individual who is able to recollect the time when the way of life was wholly native. Under these circumstances, then, "Indian" employed in a cultural sense becomes a relative, not an absolute, term. In a very general way, we may define Indian culture as a way of life in which the content and orientation are predominantly indigenous.[4] For the sake of clarity, we will employ the term "Recent Indian" in the sense used by La Farge to differentiate between contemporary indigenous culture and that of the pre-Columbian aborigines.[5] By the same token, cultures in which the indigenous patterns have ceased to predominate (or in which they never figured to any appreciable extent) are "non-Indian."

Such arbitrary distinctions, it must be remembered, represent the judgments of the outsider, since the ways in which Peruvians classify themselves vary from one region to the next, and there is no general agreement as to what comprises Indian culture.[6] Insignia of culture are viewed as insignia of class, and what characterizes "Indian culture" and "Indian class" in one region of Peru often symbolizes "Mestizo culture" and "Mestizo class" in another. This is to say that culture patterns are taken to be symbolic of certain ways of life, and these in turn are rated in hierarchal structures which vary locally. No classificatory scheme which attempts to break down the entire population of Peru into its socio-cultural components by means of a *single set* of criteria will produce a picture which corresponds at every point to the diverse native formulations of culture and class.[7] When operating within a particular local framework, the judgment must, in the last analysis—and for purely pragmatic reasons—rest with the local people themselves, and we must reckon with their socio-cultural categories.

II

In view of the greater or lesser cultural admixture which characterizes the entire Spanish American scene (for, clearly, acculturation has not proceeded everywhere at a uniform pace), it was, perhaps, inevitable that some anthropologists should have come to interest themselves in the cultures of the Ladinos or Mestizos, peoples whose ways of life are, generally speaking, "non-Indian" and "non-Spanish" but represent highly complex integrations of these two, as well as other traditions. To date, no entirely satisfactory and generally accepted term has been devised to serve as an overall designation for the "non-Indian," "non-Spanish" cultures of Spanish America. Collectively, they have at times been called "Creole" (from Spanish, *criollo*), at other times merely "Latin American."[8] In an earlier paper, the writer labeled this way of life, "Mestizo."[9] Spanish American terms for this type of culture and its carriers are numerous and differ from one country to the next. To mention only the more familiar, "Mestizo" is employed in Mexico,[10] "Ladino" in parts of Central America,[11] and "Cholo" in Ecuador, Peru, Bolivia, and elsewhere.[12] Local usage, however, is invariably loose and inconsistent, and the problem of socio-cultural identification is further complicated in many areas by the existence of such descriptive class terms as *los correctos* ("the correct ones") and *los tontos* ("the ignorant ones") in some Mexican towns, *vecinos* ("citizens") and *forasteros* ("outsiders") in parts of Peru, and a variety of others.[13] In general, terms of this order tend to be employed in relatively homogeneous communities where class distinctions are a matter of economic standing, family tradition, education, and so forth, rather than basic cultural differences. Although restricted space prevents further discussion of the terminological problem at the present time, it will be necessary to return to this

question in connection with our inquiry into the suitability of the term "Creole" as applied to certain aspects of contemporary Peruvian society and culture.

As descriptive data pertaining to the Ladino or Mestizo communities began to accumulate, it soon became apparent that, from Mexico to Peru, there were certain important underlying uniformities, both in regard to overt behavior patterns and to more basic attitudes and modes of thinking, which could not be explained in terms of any recent historical contacts. There are many patterns and situations in the cultures of Mitla and Tepoztlan in Mexico, for example, which are duplicated with a remarkable degree of exactitude in some Peruvian communities of the coast and highlands.[14] It is highly unlikely, however, that any resident of these Mexican towns has ever visited Peru, or that any citizen of Moche or Sicaya has traveled to Mexico. The obvious explanation, of course, is that the various Mestizo and Ladino communities of Spanish America exhibit certain clear-cut similarities because they share a common archaic Iberian heritage and because the stamp of Spanish Colonial culture is everywhere present.[15] It was the presence of these broad, basic resemblances, lending a certain apparent external unity to Spanish America, which led Gillin to formulate his concept of "Creole" or "Latin American" culture.[16] There is much to be said in favor of his proposition that "the Creole cultures of Spanish America . . . have a common general framework and a common tone which enables them to be spoken of collectively as *the* Creole culture and to be compared with *the* North American culture . . ."[17] To date, however, the formulation of "Creole" or "Latin American" culture has been couched in journalistic or impressionist terms, and meticulous analysis has been conspicuously absent. Although the hypothesis still remains to be demonstrated by means of systematic documentation, Davidson has recently made an attempt to define the content of "Latin American" culture in a highly tentative way.[18] While it appears that this type of culture is to be found in all the republics of Spanish America, there are said to be areal, regional, and local forms which are variable and may be distinguished from one another. Gillin has pointed out that, although important similarities exist throughout the area, the "Creole" cultures of Guatemala and Peru are clearly distinguishable, and that subconfigurations exist within each country.[19] Thus, he recognizes that, in Peru, the "Creole" culture of the highlands differs from that of the coast, while certain patterns differentiate the coastal towns of Moche and Cañete.[20] He also states that "Creole" or "Latin American" culture may be manifested in a variety of social situations within a given republic, and that "rural" and "urban" phases may be discerned.[21]

In the conclusions of his study of Moche, Gillin has recently made the plea that we recognize the contemporary "Creole" cultures of Spanish America as cultures in their own right, as new syntheses and reintegrations in new contexts of elements from diverse sources.[22] With special reference to the situation in Peru, he writes that "the Creole culture, which some day may justly be called Peruvian culture, is not a servile copying of either foreign or indigenous models, but a new and vigorous expression of national life."[23] While this "emerging Creole culture" is still in the process of consolidation, "the Peruvian Creole culture is a new synthesis."[24] In brief, Gillin sees contemporary Peruvian culture as divisible into two major types: Recent Indian (which, following Kubler, he designates "Republican Native") and Creole.[25]

III

Let us now examine this position point

by point, returning first to the vexing problem of terminology. As we have seen, Gillin has designated the "non-Indian", "non-Spanish" culture of Spanish America "Creole," and has also applied this term to a particular culture which he postulates as emergent in Peru. He objects to the use of the word "Mestizo" in a cultural sense because it carries with it the implication of race mixture.[26] "At present," he writes, "some pure Indians on the one hand and some pure whites on the other hand, *as well as most Mestizos,* participate in the development and performance of the Creole culture . . ."[27] Those who participate in the Recent Indian cultures of Peru, however, are either pure Indian racially or at least have a proportionately large amount of Indian blood.[28] While it is true, of course, that there appears to be no inherent relationship between race and culture, it is equally true that genetic hybridization in Peru has everywhere accompanied acculturation, and it is an undeniable fact that the majority of the carriers of "Creole" culture are, genetically, Mestizos.

As a cultural term, "Creole" is scarcely more suitable than "Mestizo," since biological connotations are equally implicit—*i.e.,* the purity of strain, rather than race mixture, is stressed. With regard to the use of the word in nineteenth-century Peru, Tschudi wrote: "The designation Creole properly belongs to all the natives of America born of parents who have emigrated from the Old World, be those parents Europeans or Africans. There are, therefore, white as well as black Creoles."[29] That the biological emphasis was paramount is unquestionable: "The Spaniards apply the term *criollo* not merely to the human race, but also to animals propagated in the colonies, but of pure European blood . . .".[30] Although, at the present time, the word is employed in a variety of contexts, Romero uses *criollo* to mean *"descendiente directo del español."*[31] In addition to its original racial meaning, however, the term has been extended by usage, and has taken on certain cultural implications. Often, it designates what is native as opposed to what is foreign. The *"vals criollo"* is a native waltz (in the Spanish tradition) in contradistinction to the American or Bavarian waltz, while *"criollo* food" refers to dishes prepared in the Lima manner rather than to foreign food or to other native cookery. The term may even be employed in a loose, nationalistic sense; golf matches in Arequipa between British and American club members on the one hand and Peruvian members on the other were often framed as *"gringos" versus "criollos."* In Lima, the word has the added significance of one born in the capital as opposed to the *"serranos,"* or highlanders.

The question, however, of whether "Creole" or some other term should be employed to designate the "non-Indian," "mixed" cultures of Peru would be idle and inconsequential were it not for the fact that *"criollo"* (or Creole), as a cultural term, should be reserved more properly for a way of life which is vastly different from that of the Mestizos, or of the Indians.[32] The true *criollo* culture of Peru, unfortunately, has received no systematic attention in scientific literature; it has attracted neither the anthropologist nor the sociologist. Yet descriptions of it are to be found in memoirs, diaries, and journals, and especially in Peruvian novels.[33] Strictly speaking, *"criollo",* employed in a cultural sense, designates a post-Colonial Spanish way of life which, fundamentally, is rooted in neither archaic Iberian nor in indigenous Peruvian culture. It derives rather from the late eighteenth- and nineteenth-century Spanish culture, and is tinged with strong French influences. Although no summary of content is attempted here, the way of life of the Lima *criollos,* as described by Tschudi, reveals virtually nothing of "Indian" tradition.[34] As its carriers were true *criollos* racially, so the culture was *criollo* in a very real sense, modeled in the image of

Spain. This Spanish derived and oriented *criollo* culture is preserved today as the class culture of the old-guard aristocrats of such cities as Lima and Arequipa, and, to an even greater extent, of Trujillo, Piura, and Tacna. Since it is today exclusively a class culture, and is nowhere shared by all the members of any community, this way of life tends to be designated by class terms. In Lima and Arequipa, it is usually called *"alta sociedad"* ("high society"), while in Cuzco it is known as *"jailé"* (from English "high life"). Gradually, owing to increasingly intensive contacts with other contemporary cultural centers, especially London, Paris, and New York, and to the progressive breakdown of regionalism in Peru, *criollo* culture is tending to lose its marked Iberian bias and to merge more and more with modern Western civilization.

To sum up, then, it appears singularly inappropriate to employ a term which denotes purity of strain to designate a culture of mixed Indian and Spanish tradition, especially when another term, in which the concept of mixture is implicit, is ready at hand. The mixed culture, characteristic of most Peruvian Mestizos, will hereafter be called "Mestizo" culture; "Creole" (or *"criollo"*) will designate a variant of post-Colonial Spanish culture whose carriers are, in the main, the Peruvian-born descendants of Spaniards.

Let us now consider the content of "Creole" culture as defined by Gillin and as outlined tentatively by him in the conclusions of his Moche report. In all honesty, it must be stated that he attempted no formal analysis, and that his remarks are intended merely "to suggest that Creole culture is a synthesis of elements drawn from various sources and that the Spanish stamp gives to this general mode of life a certain external uniformity . . ."[35]

Yet an examination of the patterns which are taken to be the diagnostics of "Creole" culture reveals at once that these are *all*—with the exception of such aspects of the intellectual content as ideas borrowed from Marxism, the Enlightenment, and from the French and American Revolutions—of Spanish origin.[36] They include such traits as Iberian Catholicism, concepts of "personal honor" and of Roman law, the plaza in town planning, the use of broad-brimmed hats, ceremonial kinship, and such features of domestic architecture as the patio and the barred window, to mention but a few. But although Gillin writes that ". . . almost everywhere the Creole culture has been strongly influenced by aboriginal elements," no aboriginal patterns whatever figure in the cultural content as formulated.[37] The exclusive emphasis on the Spanish patterns tends to obscure the fact that what really characterizes this way of life is the fusion and mixture of Spanish culture with Indian tradition. The very omission of the Indian elements suggests what we actually find to be the case, namely, that the indigenous components of Mestizo culture vary from one region of Peru to another, that there appear to be no indigenous common denominators or, at best, very few.

Let us compare very briefly the indigenous components of three Peruvian Mestizo cultures: Yucay, Sicaya, and Moche.[38] (For a general map of Peru, see FIGURE 1.) What follows is not intended to constitute a definitive analysis, but rather to suggest that the indigenous content of Mestizo culture in one region is apt to be almost totally dissimilar to that of another. In respect to the three communities considered here, the Indian-derived patterns listed below which are characteristic of any one are not, to the best of the writer's knowledge, shared by the other two.

Some indigenous components of Yucay Mestizo culture may be listed as follows: agriculture ritual involving libations in the fields before plowing; use of the foot plow in farming; barter in trade; jerked llama meat a staple of diet; sandals habit-

FIGURE 1.

ually worn by both sexes; wrap-around skirt for toddlers; knitted caps for children, and worn in bed by adults; end flutes and pan-pipes important musical instruments; Indian-type dance (*cachar-pari*) at Carnival; beliefs that certain diseases are caused by evil springs, the earth, the rainbow, and by souls of the dead; belief in a type of witch who steals human fat; belief in the *Ccoa,* a supernatural cat, the sponsor of sorcerers[39]; divination with coca leaves; belief in a flying head demon.[40]

The following Indian-derived patterns are components of the Mestizo culture of Sicaya: animal increase rites; labor exchange, *uyay,* in house building; Indian-type distaff in spinning; moiety division of the town; *palomay,* moral advice given to newlyweds by an aged relative or respected citizen; *palpa,* presents of livestock, building timbers, or cash given to newlyweds; newborn infant's umbilical cord cut with a potsherd; joking and games at funerals; funeral feast for relatives and friends; food, coca, and alcohol offered to the dead; coca chewed ceremonially; separation of the sexes on ritual occasions; belief in the *amaru,* a thieving mythical serpent-monster.

The Mestizo culture of Moche has incorporated such indigenous patterns as the use of meandering irrigation ditches; Indian fishing techniques, and the importance of fish, crabs, and shrimp as foods; the eating of lizards and iguanas; drinking gourds; balsas; wattle-and-daub houses; sleeping mats; the practice of going barefoot; rite occasioned by the first cutting of a child's fingernails; the use of white corn meal for purification; the separation of "white" and "black" magic.[41]

Certain indigenous patterns, on the other hand, are shared by two of the three communities here considered, but are absent in the third. Witchcraft beliefs and the use of alcoholic *chicha,* for example, are characteristic of Moche and Yucay, but not of Sicaya. In both Sicaya and Moche, guinea pigs are employed in the diagnosis of disease, but this is not true of Yucay. Again, while guinea pigs are raised for food in Yucay and Sicaya, they are not in Moche. While the loss of certain Indian-derived patterns in a particular Mestizo community may be postulated to explain apparent differences in indigenous content when two Mestizo cultures are compared, such an explanation, to be acceptable, must be documented with proof, and such proof is usually exceedingly difficult to obtain. It is more probable, the writer believes, that such differences are to be attributed in the main to varying factors in the acculturation processes during the Colonial era, and to basic differences in the contents of the several indigenous cultures at the time of the Conquest.

Although the Spanish Colonial ingredients of "Creole" culture do lend a certain superficial uniformity to the com-

ponent local cultures, closer inspection reveals that these are by no means identical wherever they occur. The patterns of ceremonial kinship, for example, differ greatly in degree of elaboration in Moche and in Yucay, and the Spanish-derived features of political organization which characterize Yucay are not identical with those of Sicaya. Many of the patterns, moreover, which are taken as diagnostics of "Creole" culture, are shared by groups who consider themselves (and are so judged by outside observers) to be Indians. Ceremonial kinship, the plaza in town planning, and elements of Roman Catholic ritual, to cite but a few examples, are common to Recent Indian and Mestizo cultures alike.

In addition to differences in content, the various Mestizo cultures of Peru are further differentiated in respect to general orientation. What appears to make the basic difference in orientation—and also, to a not inconsiderable extent, in content—is the place which a given Mestizo culture occupies within the framework of a particular local hierarchal structure. Thus, for example, in the village of Chucuito where Aymara Indian peasants comprise the bulk of the population, the Mestizos form a small, "aristocratic" class. As such, they abstain from all manual labor, practice no agriculture, engage in no handicrafts, and affect the manners and customs of the *criollos* of southern Peru.[42] Their way of life and general orientation is vastly different from that of the fishermen of Moche or the farmers of Sicaya. Thus, Mestizo culture might quite properly be termed "aristocratic" in caste-structured Chucuito, "rural" in classless Moche, and "middle class" in class-structured Arequipa.

It would appear, therefore, in the light of the evidence, that we are not justified in speaking of "*the* Peruvian Creole culture"; instead, we must recognize a series of local "Creole" or Mestizo cultures. Save for some patterns which derive from a common Spanish heritage, these local cultures are characterized merely by being neither predominantly indigenous nor predominantly Iberian Spanish. After the shared Spanish-derived patterns have been factored out, a miscellaneous hodgepodge of indigenous custom remains which is different in each region of Peru. It is true, of course, that each local "Creole" culture has achieved *an* integration, but this is not *the one and only* integration. We can subscribe to the proposition that, some day, we shall be able to speak justly of "Peruvian culture," but that day has not yet arrived.[43] *"Peruanidad,"* a word coined recently in Peru to describe a hypothetical national cultural unity, is not to be referred to any particular way of life participated in by all Peruvians. The word merely reflects the nationalistic political trend of the times; it designates the total cultural heritage of Peru, but has no specific locus in time or space.

Neither does it seem justifiable to speak of "Creole" culture as "emergent."[44] Each and every culture, of course, is a product of its total history, and since each is constantly in a state of change (however great or small), any culture, at a given point in its development, might properly be termed an "emergent" culture. The use of this word, however, carries with it an implication of recency, whereas it is evident that the processes of reintegration and synthesis were advanced in Spanish Colonial times.[45] "Creole" culture is not a new synthesis; rather, it is a reflection of what survives of Colonial Spain. What is happening in Peru today is that, owing to improved transportation, communication, and educational facilities, local cultures have recently begun to lose their distinctiveness. In all probability, this leveling process will eventually produce a national culture; but national culture in Peru is far from being an accomplished fact.

IV

Our chief concern in the foregoing dis-

cussion has been with certain problems of classification, and classifications, it must be remembered, are artificial constructs, not "objective realities." It may not be argued, therefore, that some are "true" while others are "false." The merit of a particular classification, so long as it embraces the "facts" without violence and distortion, may be judged only in regard to the degree to which it is useful or not useful in dealing with a given problem or set of problems. It is in this sense that we must evaluate Gillin's concept of "Creole culture."

The writer's principal objection to this term is that it is made to embrace two concepts of very different orders: (1) a "culture area"; and (2) a specific culture. The patterns which have been selected as diagnostics of this way of life are, with one exception, derived exclusively from Spanish culture. On the level of "culture area," the concept of *Creole* culture is most useful in calling attention to the fact that the various Mestizo peoples of Spanish America share some patterns which serve to differentiate their way of life from those of, say, North America or China. The choice of the word "Creole" is, nevertheless, unfornate for reasons stated above, and it would be preferable, perhaps, to substitute "Modern Latin American" or "Recent Spanish American," or some such term, as a label for "Creole" culture considered as a "culture area."

But while *Creole culture* has been used in a general sense to designate a *type of culture* (Mestizo) found throughout Spanish America, *the Peruvian Creole culture,* defined in terms of the same set of criteria, has been employed in a specific sense to designate a *particular culture* in Peru. The recognition of local, regional, and class variations merely serves to indicate that, used in the latter sense, the concept is too inclusive and all-embracing to contribute materially to a better understanding of the nature of Peruvian society and culture. Brew has pointed out the danger, in classification, of "overemphasizing single criteria or selected groups of criteria which, although of value in studying those particular characters, cannot fail to give a warped picture of the whole."[46] What is delimited by the diagnostics of Peruvian Creole culture is not only virtually pan-Peruvian; it is pan-Spanish American. The concept as formulated is too general to distinguish, for example, that which is peculiarly Peruvian from that which is Ecuadorian, nor is it wholly adequate to differentiate what is essentially Mestizo from what is Recent Indian. The mere sharing of some Spanish-derived patterns seems to constitute insufficient grounds for designating such very different Peruvian Mestizo cultures collectively as *a culture;* the external uniformity imposed by selection is illusory and misleading. "Creole culture," therefore, may be employed as a label for a type of culture or it may designate a specific cultural configuration and set of patterns. It cannot, however, be made to serve both purposes.

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NOTES

[1] This paper was benefited by the helpful suggestions and criticism of Drs. Wendell C. Bennett, James A. Ford, and Sr. Gabriel Escobar.

[2] **Gillin, J.** (1942): 217.

[3] For excellent historical summaries of acculturation phases in two regions of Spanish America, see: **La Farge, O.** (1940): 281-291; **Kubler, G.** (1946): 331-410.

[4] For brief descriptions of contemporary Peruvian cultures which are predominantly indigenous in character, see: **Mishkin, B.** (1946): 411-470; **Tschopik, H., Jr.** (1946): 501-573.

[5] **La Farge, O.** (1947): xv. Care should be taken not to confuse the term "Recent Indian" with "El Nuevo Indio", a concept of J. Uriel García which, in a cultural sense, means "Mestizo" and not "Indian." **(García, J. Uriel,** 1930.)

[6] The definition of "Indian" in Peru, as elsewhere in Latin America, is primarily a problem of culture rather than of race. See: **Tschopik, H., Jr.** (1947): 11-14; **Tax, S.** (1942): 43-48; **Steward, J. H.** (1945): 293-294; **Gámio, M.** (1945): 410-415.

[7] The writer recently experienced great difficulty in attempting to apply uniform cultural criteria, for the purpose of identifying social groups, to a relatively small region of the Peruvian highlands. **(Tschopik, H., Jr.** (1947): 11-15.)

[8] **Gillin, J.** (1947a): 151; (1947b): 224.

[9] **Tschopik, H., Jr.** (1947): 14. Saenz has also employed "Mestizo" in a cultural, as well as a racial, sense with reference to the Peruvian situation. **(Saenz, M.** (1933): 261-278.)

[10] **Redfield, R.** (1941): 25, 74-76; **Beals, R. L.** (1946): 210-213.

[11] **Wisdom, C.** (1940): 222-225; **Gillin, J.** (1945): 1-14.

[12] **Parsons, E. C.** (1945): 1; **Tschopik, H., Jr.** (1947): 11, *n.* 6. The term "Cholo" is employed in a racial sense (to mean "mixed-blood") in Bolivia, where it is highly probable that the word also designates a type of culture as well. **(La Barre, W.** (1948): 45.)

[13] **Redfield, R.** (1930): 68; **Tschopik, H., Jr.** (1947): 38-39. For a discussion of the usage of such terms in four Yucatan communities, see: **Redfield, R.** (1941): 58-85.

[14] **Parsons, E. C.** (1936); **Redfield, R.** (1930); **Gillin, J.** (1947a); **Tschopik, H., Jr.** (1947).

[15] **Gillin, J.** (1947b): 244-245.

[16] For concise summaries of this concept, see: **Gillin, J.** (1947a): 151-160; (1947b): 243-248.

[17] **Gillin, J.** (1947a): 151.
[18] **Davidson, W.** (1947).
[19] **Gillin, J.** (1947a): 152.
[20] Idem.
[21] **Gillin, J.** (1947b): 246.
[22] **Gillin, J.** (1947a): 151-152.
[23] Ibid.: 153.
[24] Idem.
[25] Ibid.: 152; **Kubler, G.** (1946).
[26] **Gillin, J.** (1947b): 244.
[27] **Gillin, J.** (1947a): 151. Italics mine.
[28] Saenz cites some cases where individuals who are undoubtedly Mestizos genetically have "reverted" to a Recent Indian way of life and consider themselves to be Indians; such cases, however, must be regarded as most exceptional. (**Saenz, M.** (1933): 272.)
[29] **Tschudi, J. J. v.** (1847): 80. Similarly, in Louisiana under French domination, "Creole" designated those born in colonial territory of French parentage; the notion that "Creole" here implied a mixture of Negro and White is a popular misconception.
[30] Idem, footnote.
[31] **Romero, E.** (1928): 178.
[32] Gámio, too, finds it necessary to distinguish between "Mestizo" and "*criollo*" in respect to the Mexican situation. (**Gámio, M.** (1945): 407.)
[33] The memoirs of Flora Tristán describe in detail the life of the Arequipa *criollos* during the early nineteenth century. (**Tristán, F.**, 1946.) The late nineteenth-century *criollo* culture of Cuzco is abundantly documented in the novels and other writings of Clorinda Matto de Turner (1854-1909).
[34] **Tschudi, J. J. v.** (1847): 65-74, 89-110. For further details of Lima criollo culture, see: **Díez Canseco, J. L.** (1934).
[35] **Gillin, J.** (1947a): 152.
[36] Ibid.: 151-152.
[37] **Gillin, J.** (1948): 33.
[38] The data pertaining to Yucay were kindly furnished by Sr. Gabriel Escobar, a Peruvian citizen who resided in that town for a number of years. Sicaya was studied by the writer, Sr. Escobar, and Sr. Jorge C. Muelle on behalf of the Institute of Social Anthropology of the Smithsonian Institution and the Instituto de Estudios Etnológicos of Lima. Gillin's Moche report has furnished the data on that coastal community. (**Gillin, J.**, 1947a.)
[39] *cf.* **Mishkin, B.** (1946): 463-464.
[40] *cf.* **Tschopik, H., Jr.** (1946): 560.
[41] *cf.* **Tschopik, H., Jr.** (1946): 564-566.
[42] Chucuito was studied by the writer during 1940-1942 on behalf of the Division of Anthropology and the Peabody Museum of Harvard University.
[43] **Gillin, J.** (1947a): 153.
[44] Idem.
[45] **Kubler, G.** (1946): 345-353.
[46] **Brew, J. O.** (1946): 47.

SECTION OF PHYSICS AND CHEMISTRY

THE RATE OF DISSOLUTION OF METALS IN AQUEOUS REAGENTS

By CECIL V. KING*

THE DIFFUSION LAYER THEORY. In 1897, Noyes and Whitney published measurements of the rate of solution of benzoic acid and lead chloride in water.[1] They used cylinders of these materials, 8 x 2 cm. cast on glass rods, as cores; a cylinder was mounted in a flask containing water and the whole was rotated at about 60 r.p.m. To explain the results, they suggested that an extremely thin layer of saturated solution is formed at the solid surface and that the observed rate is determined by diffusion away from this layer.

In 1904 Nernst presented a clearer picture of this "diffusion theory."[2] He suggested that, since in many cases there is a very high difference in chemical potential at the interface, it is reasonable to expect an extremely fast chemical reaction. The observed rate would then depend upon the geometric relations of the apparatus used, the intensity of the convection currents set up, and the diffusion coefficient of the reagent. The various factors could be expressed in the equation

$$dx/dt = D\,A\,C/\delta \qquad (1)$$

where D is the diffusion coefficient, A the area of solid, C the concentration difference at the surface and in the solution, and δ the thickness of the layer in which a concentration gradient exists.

The theory was elaborated somewhat by Brunner,[3] who supported it with new experiments using benzoic acid; magnesia and magnesium metal dissolving in acids; and electrolytic experiments in which concentration polarization is found. Brunner realized that the concentration gradient might not be entirely linear and that the outer edge of the diffusion layer might not be sharply defined, and considered δ as an "effective" thickness which makes EQUATION 1 valid.

Five criteria are now generally accepted as indicative of diffusion-controlled rates[4]:

(1) Different solids dissolve at nearly the same rate in the same reagent, under the same conditions.

(2) The speed of stirring has a large effect, the exact nature of which depends on the type of stirring used.

(3) The dissolution rate is approximately inversely proportional to the viscosity, with other physical and chemical factors constant.

(4) The dissolution rates with a series of reagents are proportional to a fractional power (ca. 0.75) of the diffusion coefficients.

(5) The temperature coefficients are lower than for homogeneous reactions, usually 1.1 to 1.5 per 10° at room temperature.

NATURE OF THE DIFFUSION LAYER. The "film" or "layer" theory has found wide application in interpreting heterogeneous rates, as in the dissolution of metals and other solids, the transfer of heat to liquids or gases, the evaporation of liquids or solids, the absorption of gases or vapors, and in reactions at liquid-liquid interfaces. In most cases, the stirring or flow rates are comparatively low and it is often evident that concentration gradients extend much further from the interface than the theory implies. In this case, both convection and diffusion contribute to transport in an intermediate layer, and this has been called "eddy diffusion."

When rotating metal cylinders are used, the rate constant k becomes linear with peripheral speed above ca. 5,000 cm./min. (FIGURE 1). Under such conditions it is probable that "eddy diffusion" is confined to a layer much thinner than the "true

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[1] **Noyes, A. A., & W. R. Whitney.** Z. phys. Chem. 23: 689. 1897.

[2] **Nernst, W.** Ibid. 47: 52. 1904.

[3] **Brunner, E.** Ibid. 47: 56. 1904.

[4] **King, C. V., & M. M. Braverman.** J. Am. Chem. Soc. 54: 1744. 1932.

diffusion" layer. Only the velocity component of fluid motion perpendicular to the solid surface is important in determining the relative effects of convection and diffusion on the rate.[5] It has been shown that turbulent flow near a pipe wall is essentially laminar because the perpendicular component (v) becomes very small.[6] It has been suggested[7] that the relation between dissolution rates and diffusion coefficients can be explained by an exponential increase of the turbulence component v with distance in the proper range (distance $d = 1$ to 50 microns).

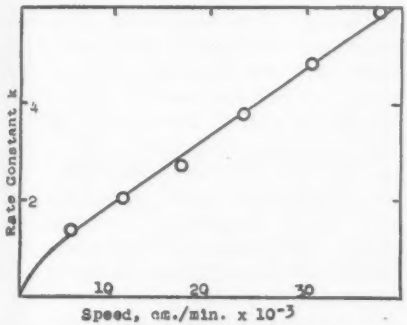

FIGURE 1. Effect of peripheral speed on rate of dissolution of magnesium cylinder in HCl.[4]

Assuming the relation (FIGURE 2):

$$v = ad^3 \qquad (2)$$

where a is a constant, the rate of convective transport toward the surface, in equivalents n of reagent per unit time is given by

$$dn/dt = ad^3\,AC \qquad (3)$$

where A is the area of solid, c the reagent concentration. Fick's law for diffusion through a linear concentration gradient is

$$dn/dt = D\,A\,C/\delta \qquad (4)$$

where D is the diffusion coefficient. If it

[5] **Van Name, R. G., & D. U. Hill.** Am. J. Sci. (4) **36**: 543. 1913; **42**: 307. 1916.
[6] **Fage, A., & H. C. H. Townend.** Proc. Roy. Soc. London **A135**: 656. 1932.
[7] **King, C. V.** Report of University Conference on Corrosion and Metal Protection, Chicago (June, 1947). To be published.

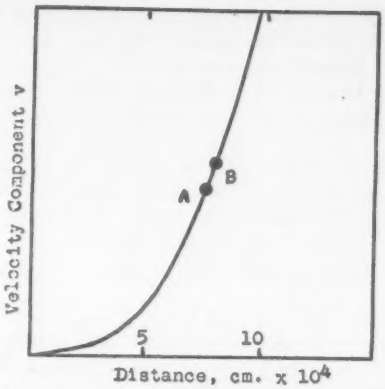

FIGURE 2. Suggested relation between perpendicular component of turbulent flow and distance.

is assumed that eddy diffusion is found essentially in only a thin layer between points A and B of FIGURE 2, *i.e.*, that transport is sensibly only by diffusion to the left of A and that the solution is homogeneous to the right of B, EQUATIONS 3 and 4 may be combined by setting $d = \delta$ at an intermediate point. Then,

$$a\delta^3 = D/\delta \quad \text{and} \quad \delta = D^{\frac{1}{4}}/a^{\frac{1}{4}} \qquad (5)$$

Combining with the Nernst relation $k = D/\delta$, where k is the observed rate constant,

$$k = aD^{\frac{3}{4}} \qquad (6)$$

where a is a constant. It has been shown that such a relation is obeyed experimentally and may be used to compare heat transfer rates with metal dissolution rates.[8, 9]

DEPOLARIZERS. Magnesium dissolves freely in dilute acids at a rate which is presumably controlled by diffusion of acid to the surface.[8] With potassium nitrate or certain other oxidizing agents present as depolarizers, zinc, cadmium and iron dissolve, under proper conditions, at practically the same rate as magnesium.[4, 10, 11] With excess acid, the rate is controlled by

[8] **King, C. V., & W. H. Cathcart.** J. Am. Chem. Soc. **59**: 63. 1937.
[9] **King, C. V., & P. L. Howard.** Ind. Eng. Chem. **29**: 75. 1937.
[10] **King, C. V.** J. Am. Chem. Soc. **57**: 828. 1935.
[11] **King, C. V., & M. B. Abramson.** Ibid. **61**: 2290. 1939.

diffusion of the depolarizer; with excess of the latter, by diffusion of the acid.

Evidently, the function of a depolarizer is to avoid the effect of hydrogen overvoltage on the metal, and it may do this by making hydrogen evolution unnecessary. With zinc and nitrate ion in acid solution as electrode reagents, the following equations might apply:

$$\mathrm{Zn} - 2\varepsilon \rightarrow \mathrm{Zn^{++}}$$
$$\mathrm{NO_3^-} + 10\mathrm{H^+} + 8\varepsilon \rightarrow \mathrm{NH_4^+} + 3\mathrm{H_2O} \qquad (7)$$

Adopting the older theory that hydrogen overvoltage is due to the slow combination of H-atoms to form H_2–molecules, we might write:

$$\mathrm{Zn} + 2\mathrm{H^+} \rightarrow \mathrm{Zn^{++}} + 2\mathrm{H}$$
$$\mathrm{NO_3^-} + 2\mathrm{H^+} + 8\mathrm{H} \rightarrow \mathrm{NH_4^+} + 3\mathrm{H_2O} \qquad (8)$$

Depolarization would be explained by the rapid removal of H-atoms from the surface by nitrate.

Newer theory[12] postulates two energy barriers in the electrical double layer at the metal surface, with overvoltage caused by the slow passage of protons across one of the barriers. A depolarizer might conceivably function by lowering the energy barrier or by sidestepping passage of protons over the barrier while being reduced itself.

The lowest reduction potential at which an oxidation-reduction system could be expected to bring about reaction would be near the standard reversible potential of the metal itself, namely —0.76 volt in the case of zinc. Set up with a reversible electrode, any system of higher potential would cause zinc to dissolve, but in the case we are considering, if the initial attack on the metal is by acid, a somewhat higher potential may be necessary. The experiments described below were undertaken to find the potential which an oxidizing agent must possess to act as a depolarizer with zinc.

[12] **Eyring, H., S. Glasstone, & K. J. Laidler.** J. Chem. Phys. 7: 1053. 1939; **Kimball, G. E., S. Glasstone, & A. Glassner.** Ibid. 9: 91. 1941.

NEW EXPERIMENTS. Zinc cylinders, 2.54 cm. long and about 1.9 cm. in diameter, were rotated at 3100 to 3150 r.p.m. in the solutions mentioned below, at 25° ± 1° C. Nitrogen was bubbled through the solutions to remove oxygen and to prevent reoxidation of reduced depolarizer. The C.P. zinc used dissolves at an appreciable rate in dilute acid alone and this rate increases with time. Blanks were run but could not be used consistently as corrections. Some depolarizers appear to eliminate or minimize this spontaneous rate except when very dilute.

Potassium nitrate. It has been shown previously[13] that, with excess potassium nitrate and dilute acetic acid buffer, first-order rate constants are obtained over more than half the reaction assuming reduction to nitrite. New work indicates that, with excess hydrochloric acid, nitrate is reduced to ammonium ion. The rate is not first-order under the conditions used (FIGURE 3), but the total amount dissolved agrees well, as shown in TABLE 1. In the acid alone, 10-minute blanks gave 1.8 and 1.3 mg. losses, and there is a similar weight loss after all nitrate is reduced.

[13] **King, C. V., & M. Schack.** J. Am. Chem. Soc. 57: 1212. 1935.

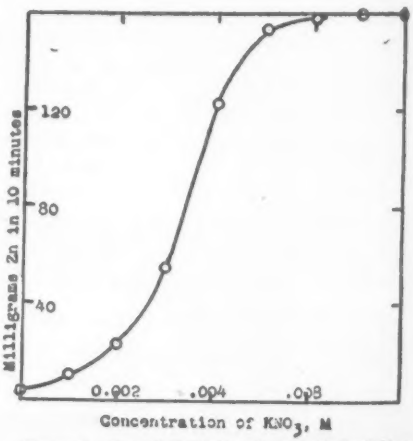

FIGURE 3. Rate of dissolution of zinc cylinder 2.54 x 1.92 cm., 3150 r.p.m., 1000 ml. 0.0182 M HCl + KNO_3, 25°.

The zinc was weighed and polished at intervals given. Values of k in TABLE 1 were calculated as if the rate were first order, using the equation

$$k = \frac{2.3\,V}{A\,t} \log \frac{a}{a-x} \qquad (9)$$

where V is the volume of solution, a the total theoretical amount of zinc dissolved.

TABLE 1

ZN CYLINDER IN 100 ML. 0.091 M HCL, 0.004 M KNO_2, 25°, 3100 R.P.M.

Time, min.	Zn dissolved, mg.	k
5	43.1	0.65
10	35.9	.59
10	14.8	.57
20	10.2	
10	3.8	—total 107.8
10	1.8	theory 104.6

The irreversible potential of the nitrate-acid system is sufficiently high to oxidize zinc at a diffusion-controlled rate at all feasible values of pH.

Quinone. The quinone-hydroquinone system was chosen as one of known reversible potential which varies with pH. TABLE 2 shows that, with hydrochloric acid and excess quinone, the rate is first-order with respect to HCl although the potential decreases considerably as acid disappears and hydroquinone is formed. With excess acid, the rate is nearly first-order with respect to quinone; k increases somewhat with time, probably because a little hydrogen is evolved. The total metal dissolved in 55 minutes was actually 214 mg. The higher rate in excess quinone is typical of the higher diffusion coefficient of the hydrochloric acid.

TABLE 2

THE RATE IN ACID AND QUINONE SOLUTIONS

Time, min.	x, mg.	k
200 ml. 0.0182 M HCl, 0.04 M Quinone		
3	50	2.46
3	31.5	2.62
4	20.7	2.62
5	9.2	2.46
∞	111.4 (theory)	
200 ml. 0.091 M HCl, 0.015 M Quinone		
4	55.9	0.99
6	50.8	1.05
6	33.7	1.04
6	23.0	1.08
∞	196 (theory)	

TABLE 3 shows the effect of adding hydroquinone (HQ) and of using an acetic acid buffer. Values of k are for the first 4 to 11 minutes, and the approximate potential E is for half-reduction of the quinone. The smaller rate in the buffers is partly (4%) due to the higher viscosity, may be partly due to the lower potential.

Methylene blue. The potential of the methylene blue-methylene white system has been studied by Clark, Cohen, and Gibbs.[14] Over the range of pH in which

[14] Clark, W. M., B. Cohen, & H. D. Gibbs. U. S. Public Health Service, Hyg. Lab. Bull. 151: 174. 1928.

TABLE 3

THE RATE IN STRONG AND WEAK ACIDS

Acid	Quinone	H Q	k	E, volt.
0.091 M HCl	0.01M	——	0.95	0.64
	.01	.01M	.95	.62
	.01	.02	.97	.62
	.01	.03	.96	.61
0.108 M HAc,	.01	——	.86	.40
0.10 M NaAc	.01	.01	.85	.39
	.01	.02	.84	.38
	.01	.03	.82	.37

we are interested, the potential at half-reduction is given approximately by the equation

$$E = 0.53 - 0.09 \log 1/C_{H^+} \quad \text{(at 30°)} \tag{10}$$

The most striking factor in the action of methylene blue on zinc with hydrochloric acid is that it catalyzes hydrogen evolution, and 32 to 40 equivalents of zinc dissolve per mole of dye reduced. The rate is closely first-order, which indicates that the catalysis is proportional to the concentration of the blue and not the white form. A typical experiment is shown in TABLE 4. After the color disappears, the rate drops to one or two mg. per 10 minutes, and the value of a used in the rate equation is the total zinc dissolved up to this point.

TABLE 4

THE RATE IN 75 ML. 0.105 M HCL, 0.002 M METHYLENE BLUE AT 25°, 3150 R.P.M.

Time, min.	Zn dissolved, mg.	k
6	30.3	0.118
8	34.4	.125
10	35.6	.122
12	33.6	.127
12	26.9	.127
20	32.2	.130
∞	(206)	

Attempts were made to measure a rate constant colorimetrically. However, these were impeded by the cloud of tiny hydrogen bubbles which remains suspended a long time, and by reoxidation of the methylene white. With improved technique, the measurements should be possible.

TABLE 5

THE RATE IN VARIOUS SOLUTIONS, 25°, 3150 R.P.M., 75 ML. SOLUTION

Acid	$C_{\text{Me blue}}$	Time min.	Zn dissolved, mg.	E
0.108 M HAc + .10 M NaAc	0.01	4	2.8	0.08
	——	4	2.5	
0.108 M HAc + .10 M NaAc	.004	20	16.0	
	——	20	19.4	
0.1 M HAc	.004	20	33.6	.25
	——	20	24.0	
0.1 M HAc + .04 M HCl	.002	k ~	0.103	.40
0.105 M HCl	.002	20	73	.45
	——	20	37	

The experiments of TABLE 5 were run with a zinc cylinder which dissolved undesirably fast in acids alone. However, they indicate that methylene blue does not act as a depolarizer at all in an acetic acid buffer of pH ~ 5, and that the rate is intermediate at lower pH values. A zinc cylinder was rotated 110 minutes in the acetic acid buffer with 0.004 M methylene blue; it lost 62 mg. and became rough, pitted and considerably stained, but the solution lost little color. With 0.1M HCl, decolorization is almost complete in 80 minutes.

The catalysis of hydrogen evolution is probably connected with the fact that reduction of methylene blue requires two electrons but only one hydrogen ion per molecule:

$$C_{16}H_{18}N_3S^+ + H^+ + 2\varepsilon \rightarrow C_{16}H_{19}N_3S \tag{11}$$

The experiments reported here suggest that the metal is primarily attacked by the hydrogen ion, that the dye is absorbed and lowers the potential barrier in the over-all process

$$2H^+ + 2\varepsilon \rightarrow H_2$$

Obviously, further experiments with other oxidation-reduction systems are desirable, in strongly acid and buffered solutions and with pure zinc which has a lower spontaneous rate. A few experiments with indigo disulfonate indicate that it has a rather small depolarizing action, with $E \sim 0.27$ volt.

Note. A special lecture was held on April 28, 1948, at which Doctor Jean Pasteels, Laboratoire d'Anatomie et Embryologie Humaines, Université Libre de Bruxelles, Bruxelles, Belgium, presented a paper entitled *The Evolution of Nucleic Acids in the Germinal Cycle of* Ascaris megalocephala, *as studied by Cytochemical Methods,* illustrated by lantern slides. This will be published in Volume 11 of TRANSACTIONS.

CONFERENCES HELD

SECTION OF PHYSICS AND CHEMISTRY

CONFERENCE ON "MOLECULAR INTERACTION": APRIL 9 AND 10, 1948

The Section of Physics and Chemistry held a Conference on "Molecular Interaction." Doctor R. M. Fuoss, Yale University, New Haven, Connecticut, was the Conference Chairman in charge of the meeting. Doctor P. Debye, Cornell University, Ithaca, N. Y., was the Presiding Chairman at all sessions.

The program consisted of the following papers:

Friday, April 9

Morning Session. "Introductory Remarks," by the Conference Chairman.

"Colloidal Electrolytes," by P. Debye, Cornell University, Ithaca, N. Y.

"The Role of Hydration in the Debye-Hückel Theory," by R. A. Robinson, Yale University, New Haven, Connecticut, and R. H. Stokes, Cambridge University, Cambridge, England (presented by title).

"The Brönsted Work Principle: Thermoelectric, Galvanic and Thermo-Chemical Cells," by O. Foss, The Rockefeller Institute, and V. K. LaMer, Columbia University, New York, N. Y.

"The Effect of Shape on the Interaction of Lyophilic Colloids," by L. Onsager, Yale University, New Haven, Connecticut.

"The Attractions of Proteins for Small Molecules and Ions," by G. Scatchard, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Afternoon Session. "Determination of the Dissociation of Constants of Weak Electrolytes in Salt Solutions," by M. Kilpatrick, Illinois Institute of Technology, Chicago, Illinois.

"Kinetics of the Formation of Monodisperse Sulfur Sols," by V. K. LaMer and E. M. Zaiser, Columbia University, New York, N. Y.

"Thermal Properties of Electrolytic Solutions and the Debye-Hückel Theory," by F. T. Gucker, Jr., Indiana University, Bloomington, Indiana.

"Interactions Between Water Molecules and High Polymers," by M. Dole and I. L. Faller, Northwestern University, Evanston, Illinois.

"The Scientific Contributions of Grinnell Jones," by M. Dole, Northwestern University, Evanston, Illinois (presented by title).

Saturday, April 10

Morning Session. "Pressure-Volume-Temperature Relations in Some Solutions of Electrolytes," by R. E. Gibson, Applied Physics Laboratory, Silver Springs, Maryland.

"Extrapolation of Apparent Molal Properties of Strong Electrolytes," by B. B. Owen and S. R. Brinkley, Jr., Yale University, New Haven, Connecticut.

"The Surface Tensions of Aqueous Solutions of Sulfuric Acid," by T. F. Young, University of Chicago, Chicago, Illinois.

"Diffusion Coefficient of Potassium Chloride," by H. S. Harned and R. L. Nuttall, Yale University, New Haven, Connecticut.

Afternoon Session. "Some Interactions in Solutions of Electrolytes," by C. A. Kraus, Brown University, Providence, Rhode Island.

"Dielectric Absorption by Ammonium Salts in Solvents of Low Dielectric Constant," by R. H. Cole and H. A. Strobel, Brown University, Providence, Rhode Island.

"Factors Influencing the Properties of Long Chain Electrolytes in Water and in Mixtures of Water and Other Solvents," by P. F. Grieger, Brown University, Providence, Rhode Island.

"The Viscosity of Mixtures of Polyelectrolytes and Simple Electrolytes," by R. M. Fuoss and U. P. Strauss, Yale University, New Haven, Connecticut.

NEW MEMBERS

Elected April 22, 1948

SUSTAINING MEMBERSHIP

Beube, Frank E., L.D.S., D.D.S. Assistant Clinical Professor; Acting Head, Division of Periodontia, College of Dentistry, Columbia University, New York, N. Y.

ACTIVE MEMBERSHIP

Adelson, Harvey T., Student, Biochemistry, Polytechnic Institute of Brooklyn; Research, Pediatrics Research Laboratory, Jewish Hospital of Brooklyn, Brooklyn, N. Y.

Bliss, Alfred F., Ph.D., Chemistry of Visual Pigments. Associate Professor, Tufts Medical College, Boston, Mass.

Borenfreund, Ellen, B.A., Cancer Research. Student, Department of Biology, New York University, New York, N. Y.

Bowman, John R., Ph.D. Head, Department of Research in Physical Chemistry, Mellon Institute, Pittsburgh, Pa.

Bridgman, Charles S., Ph.D. Technical Director, Human Engineering Project, New York University, Port Washington, L. I., N. Y.

Brotman, Irving, M.D. Washington, D. C.

Chait, Robert A., M.D. Assistant Attending Allergist, Jewish Hospital of Brooklyn, Brooklyn, N. Y.

Cleaver, Charles S., Ph.D. Research Chemist, Experimental Station, E. I. du Pont de Nemours & Co., Wilmington, Delaware.

Cooper, Jack, Ph.G. Chief Research Pharmacist, Ciba Pharmaceutical Products, Inc., Summit, N. J.

Denes, Gyula. Director, Psychodramatic Theatre, New York, N. Y.

De Renzo, Edward C., M.S. Graduate Assistant, Chemistry, Fordham University, New York, N. Y.

Dolores, Emeterio P., M.S. Instructor in Biology, Chemistry, Zoology, College of Oral & Dental Surgery, San Beda College, Far Eastern University, Manila, Philippines.

Duryee, William R., Ph.D. Cytologist, National Cancer Institute; Staff Associate, Department of Terrestrial Magnetism, Carnegie Institution, Washington, D. C.

Elwyn, David H., B.A., Use of Isotopes in Plant Metabolism. Assistant in General Chemistry; Pre-Doctoral Research Student, Columbia University, New York, N. Y.

Feri, George A., M.S., Analytic, Biologic & Organic Chemistry. Maltine Co., Morris Plains, N. J.

Ford, Mary Fox, M.A. Teacher, Biology Department, Lindenhurst High School, Lindenhurst, L. I., N. Y.

Garman, Raymond L., Ph.D., Chemistry, Physics. Director of Research, General Precision Laboratory, Inc., Pleasantville, N. Y.

Genest, Jacques, M.D. Commonwealth Fund Fellow; Assistant in Medicine, Johns Hopkins Hospital, Baltimore, Md.

Gilbert, Harry B., M.A. School Psychologist, Board of Education, New York, N. Y.

Grafflin, Allan L., M.D. Senior Fellow in Cancer Research; Professor-elect, Anatomy, Johns Hopkins Medical School, with New York University, New York, N. Y.

Grieco, R. Vincent, M.D. Assistant Radiologist, Flower Hospital; Fifth Avenue Hospital, New York, N. Y.

Gustav, Alice, Ph.D. Instructor; Member of Advisement Council, Washington Square College, New York University, New York, N. Y.

Hecht, Morton, Jr., M.D., Dermatology. Great Neck, L. I., N. Y.

Isidore, Arons, M.D. Director, Radiation Therapy Department, Harlem Hospital, New York, N. Y.

Jacobi, Mendel, M.D. Physician, Bethel Hospital; Jewish Hospital, Brooklyn, N. Y.

Kaplan, Morris A., M.D. Associate, Department of Internal Medicine, College of Medicine, University of Illinois, Chicago, Ill.

Kaufmann, Berwind P., Ph.D., Cytology, Genetics. Resident Investigator, Carnegie Institute of Washington, Cold Spring Harbor, L. I., N. Y.

Keller, Martin D., M.S., Teaching Fellow, Physiology, New York University, New York, N. Y.

Kronstein, Max, Ph.D., Organic Chemistry. Research Associate; Adjunct Professor, College of Engineering, New York University, New York, N. Y.

Kushner, Samuel, Ph.D. Group Leader, Lederle Laboratories Division, American Cyanamid Co., Pearl River, N. Y.

Lambert, Robert T., M.D. Resident Psychiatrist, Taunton State Hospital, Taunton, Mass.

Lefford, Arthur, D.D.S. Instructor, Psychology, Washington Square College; Research Associate, College of Engineering, New York University, New York, N. Y.

Lehman, Arnold J., M.D., Ph.D. Chief, Division of Pharmacology, Food & Drug Administration, Washington, D. C.

Levy, Arthur L., Ph.D. Graduate Student, Physical Chemistry, Yale University, New Haven, Conn.

Leyerle, Daniel B., M.A. Chemist, Central Laboratory, Great Atlantic & Pacific Tea Co., New York, N. Y.

Lubin, Martin, M.D. Captain, Medical Corps., Army Chemical Center, Md.

Malaga-Alba, Aurelio, D.V.S., Virus, Rickettsiae. Director, Peruvian Army Veterinary Hospital, Lima, Peru.

Masia, Bertram B., B.A. Vocational Counselor, New York, N. Y.

Maurer, Paul H., M.A. Graduate Student, Biochemistry, Immunochemistry; Instructor of Chemistry, City College of New York, New York, N. Y.

Mellors, Robert C., M.D., Ph.D. Senior Fellow, American Cancer Society, Memorial Hospital, New York, N. Y.

Messer, Frederick, Ph.D. Research Chemist, Zonite Corp., New Brunswick, N. J.

Metz, Charles B., Ph.D. Assistant Professor of Zoology, Osborn Zoological Laboratory, Yale University, New Haven, Conn.

Miller, Gerald, M.D. Chief, Blood & Blood Products Section, Army Medical Center, Washington, D. C.

Perkins, Donald T., Ph.D. Meteorologist, Air Weather Service, U. S. Air Force, Washington, D. C.

Pereira-Filho, Menoel Jose, M.D., Mycology. Director, Instituto Pereira-Filho, Porto Alegre, Brazil.

Porterfield, Chester F., B.A., Biology, Physics, Chemistry. Account Executive in Scientific Advertising, L. W. Frohlich & Co., Inc., New York, N. Y.

Race, Oscar M., M.D., Pediatrics. Staten Island, N. Y.

Rockower, Leonard W., M.S. Senior Supervisor of Vocational Rehabilitation, N. Y. State Education Department, New York, N. Y.

Rodney, Gertrude, Ph.D. Research Chemist, Parke, Davis & Co., Detroit, Mich.

Rosenthal, Benjamin C., M.D. Assistant Clinical Professor, Ophthalmology, Long Island College of Medicine, Brooklyn, N. Y.

Ruoff, Paul M., Ph.D. Associate Professor of Chemistry, Syracuse University, Syracuse, N. Y.

San Pietro, Anthony, B.A. Assistant, Organic Chemistry; Pre-doctoral Research Student, Columbia University, New York, N. Y.

Sbar, Sidney, M.D., Medicine. Veterans Administrator, Manhattan Beach Hospital, Brooklyn, N. Y.

Schaefer, Louis E., M.D. Resident, Medicine, Mt. Sinai Hospital, New York, N. Y.

Schneller, George H., Ph.D. Director, Pharmaceutical Application, Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J.

Sherman, William B., M.D., Allergy. Attending Physician, Roosevelt Hospital; Assistant, Medicine, Columbia University, New York, N. Y.

Shnayerson, Edward F., M.D., Gynecology, Obstetrics. Brooklyn, N. Y.

Smith, Carl C., Ph.D. Research Associate, Merck Institute for Therapeutic Research, Rahway, N. J.

Steiner, Morris, M.D. Adjunct Pediatrician, Jewish Hospital of Brooklyn, Brooklyn, N. Y.

Stollerman, Gene H., M.D. Resident Physician, Mt. Sinai Hospital, New York, N. Y.

Sussman, Herbert M., M.A., Endocrinology. Professional Staff, E. R. Squibb & Sons, New Brunswick, N. J.

Sweigard, Lulu E., Ph.D., Human Engineering. Teacher, School of Education, New York University, New York, N. Y.

Tanenbaum, Stuart, B.S. Assistant in Organic Chemistry, Columbia University, New York, N. Y.

Titus, Harry W., Ph.D. Technical Counselor, Director of Nutritional Research, Limestone Products Corp. of America, Newton, N. J.

Weisz, Paul B., Ph.D. Instructor, Department of Biology, Brown University, Providence, R. I.

Wills, J. Henry, Ph.D. Assistant Chief, Pharmacology Section, Medical Division, Army Chemical Center, Md.

Wilson, Hildegard N., Ph.D. Assistant, Sloan-Kettering Institute, New York, N. Y.

Wittenberg, Jonathan, M.A. Graduate Student, Department of Biochemistry, Columbia University, New York, N. Y.

Wolf, S. K., M.S., Acoustic & H. F. Radio. Sales Manager, International Standard Electric Corp., New York, N. Y.

Zimmermann, Charles H., M.S. Head, Bacteriology Laboratory, Research Division, Schieffelin & Co., New York, N. Y.

STUDENT MEMBERSHIP

Brandt, Estelle, B.A. Student for M.S., Genetics, Graduate School of Arts & Sciences, New York University, New York, N. Y.

Ford, George P., M.A. Student, Department of Chemistry, Columbia University, New York, N. Y.

Holzman, Jerry. Student, Biology, City College of New York, New York, N. Y.

Kerker, Milton, M.A. Graduate Student, Physical Chemistry, Columbia University, New York, N. Y.

Mauro, Alexander, B.E.E. U.S.P.H. Junior Research Fellow, Department of Biophysics, Yale University, New Haven, Conn.

Smellie, Robert H., Jr., M.S. Ph.D. Candidate, Chemistry, Columbia University, New York, N. Y.

Wiener, Vivian S., B.S. Laboratory Assistant, Department of Biology, Newark College, Rutgers University, Newark, N. J.